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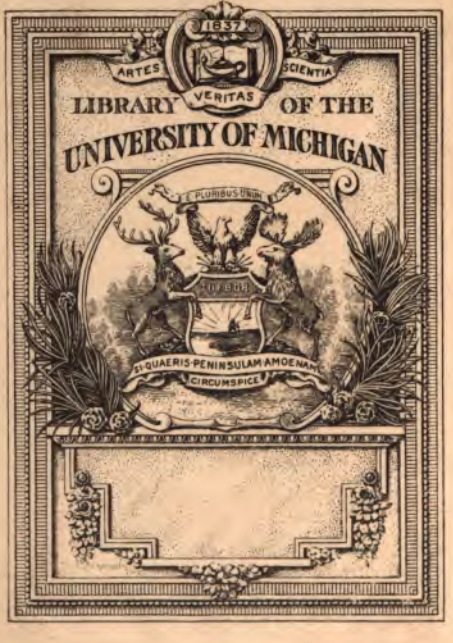
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AND

HOW TO KEEP IT.

BY

CHARLES H. BURNETT, M.D.,

Consulting Aurist to the Pennsylvania Institution for the Deaf and Dumb, Aurist to the Presbyterian Hospital, Philadelphia.

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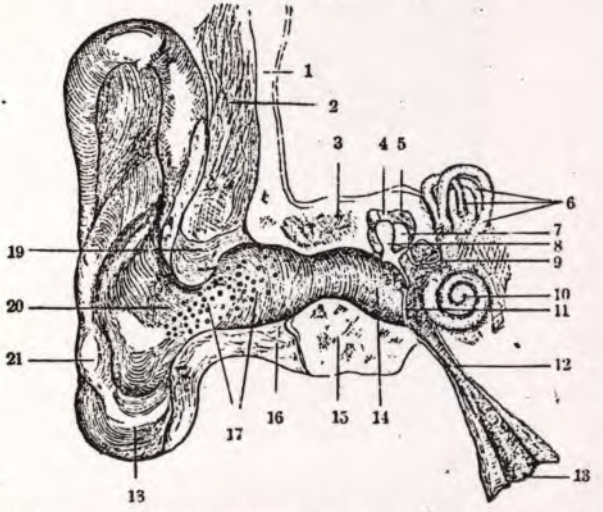
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HEARING,

AND

HOW TO KEEP IT.

PART I.

Anatomy and Physiology of the Ear.

CHAPTER I.

STRUCTURE OF THE EAR.

THE ear is the most complicated organ of special sense. Its most important parts lie deeply hidden in the hardest bone in the body, the petrous bone, and on this account its complex nature is rendered all the more difficult to study. The external ear, *i. e.* the auricle, or ear of common language, and the auditory canal which leads to the drum-head, the drum-head itself, and parts of the drum-cavity or tympanum are visible from without, and easily accessible in the living; but all other parts of the ear are not naturally visible. Furthermore, the dimensions of the various

parts of the organ of hearing, excepting the outside appendage, the auricle, are very small, and in the case of the inner ear, where the nerve of hearing is spread out, they are microscopic. At the outset, therefore, the anatomical knowledge requisite to understanding the functions of the ear is hard to get. Although it is proposed in this little book to speak chiefly of the function of the ear and how to preserve it, and also to show what should *not* be done in many cases of injury and disease of the ear, nevertheless, the entire subject will be more clearly understood, and it is hoped, more profitable, if the anatomy and some of the more important diseases of the ear are alluded to. Hence, at the beginning, we shall briefly sketch the anatomy and physiology of the entire hearing apparatus in man.

The external ear comprises the auricle, that part usually called the ear, the auditory canal, and the membrana tympani, or drum-head. The drum-head is really the partition between the external ear and the middle ear or drum-cavity, and partakes in the structures of each of these portions of the ear, as will be shown further on.

The middle ear, or drum proper—the tympanum—lies, as its name would indicate, between the external ear and the internal ear, or labyrinth.

For the present, it will be sufficient to bear in mind that the middle ear is an air-cavity, and hence a

characteristic of warm-blooded animals, or of those who live on land. It comprises the Eustachian tube, which connects it with the upper back part of the throat, and the mastoid portion of the temporal bone, parts yet to be more minutely described. The middle ear contains the smallest bones in the human body, the so-called auditory ossicles, viz., the hammer, the anvil, and the stirrup, thus named simply from their resemblance in shape to these implements.

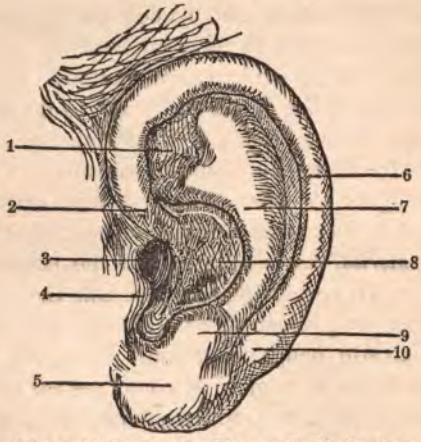
Through this important cavity, the middle ear, pass two nerves, one, the facial, on its way to the face, and the other, really a branch of the facial, the so-called cord of the drum (the chorda tympani), on its way to the tongue. A closer analysis of this cavity will be given, when its anatomy claims our special attention.

The internal ear is often called the labyrinth, on account of its perplexing structure and the obscurity which has hung about its composition and function, and which still hangs about some parts of it, so that it still deserves its name. It comprises the vestibule, an anterior part, as implied in its name, and the cochlea, or snail-shell, lying in front of the vestibule, the semicircular canals which lie behind it, and the auditory nerve, or nerve of hearing, lying beyond, between it and the brain, which sends nerve-branches to it.

This short statement will serve as a definition of the three grand divisions of the organ of hearing.

It must be borne in mind that all these parts of the ear lie very near the brain, in the temporal or petrous bone, and hence their ailments are readily communicated to the central organ of the nervous system. The petrous bone, the hardest, most rock-like bone

Fig. I.—The Auricle.



1, The pit of the anti-helix; 2, 6, 10, The so-called helix, the curved edge of the auricle; 3, The meatus, or mouth of the auditory canal; 4, The tragus; 5, The lobule; 7, The anti-helix; 8, The concha; 9, The anti-tragus.

in the frame, demands consideration, not only because it contains the ear, but also because it is an important key in the architecture of the skull, being

part of the base and side of the skull, and hence helping in the protection of the brain.

The External Ear.—The *auricle*, or ear of common language, is a shell of cartilage, covered with skin, closely fitting every groove and ridge of the underlying cartilaginous frame, excepting at its lowest pendant part. Here the skin is reflected over a cushion of delicate fat, making the *lobule*, that part to which ear-rings are usually fastened. In some cases the cartilage of the auricle dips into this cushion of fat, and when the lobule is pierced, preparatory to wearing ornaments, the cartilage is wounded, and a very painful inflammation is set up. The auricle is well supplied with blood-vessels, nerves, and lymphatics, being firmly held in place to the side of the head by ligaments, which, however, permit of a certain degree of passive mobility in man. The auricle gradually passes into the auditory canal, very much as the mouth of a trumpet fades into the tube of the instrument. The skin of the auricle, which is really part of the skin of the face, is extended into the external auditory canal, the next inner-lying part of the ear, and continues down this passage to and over the drum-head; though, of course, in the latter structure, it becomes extremely web-like and transparent.

The auricle is abundantly supplied with the little glands characteristic of the skin, viz., the sebaceous

and the sweat glands. The former secrete a natural lubricator for the skin, but are not of much importance, in this respect, in the auricle. They are most numerous in that part of the auricle called the concha, its deepest part, just at the entrance to the auditory canal (Frontispiece, 17). The entire surface of the auricle is covered with downy hairs, which, however, attain a very luxuriant and stiff growth at that part called the *tragus*, or goat (Fig. I., 4). This, doubtless, like the beard, is a protection.

The sweat glands of the auricle are most numerous on the hinder surface, an important consideration in the management of the ears of infants, for, if their auricles are pressed constantly against the head, as is too likely to be the case, softening and chafing of these parts must be inevitable.

The auricle is therefore a highly organized part of the hearing apparatus, as well as of the face and head.

Physiognomy. — The artist studies the auricle with the contours of the head and face. Praxiteles, by making the top of the auricle pointed instead of curved, in a celebrated statue, has handed down through the ages a sculpture we call his Faun. In modern literature, a hint at a similar form has been wonderfully utilized by the genius of Hawthorne, in the weird character of Donatello. In so far as the Faun of Praxiteles or the Donatello of Hawthorne were inhuman, the shape of the auricle alone has been employed to

demonstrate it in the former, and to imply it, and to excuse crime in the latter. A popular feeling is, that a small and well-shaped ear in man is not only a beauty, but a sign of good breeding; while, on the other hand, a large, prominent auricle is a sign of vulgarity. Giotto, in his drawing of Envy, in the chapel of the Arena, at Padua, represents the auricle as superhuman in size. The position of the auricle may be a national peculiarity, as in the Egyptians, in whom the auricles are placed high in the head. Considerable interest has been aroused respecting the meaning of a little point or prominent fold very often found at the upper posterior edge of the auricle in man. Both artist and anatomist have been attracted to these prominences, which have been found in the ears not only of men, but of monkeys. Advocates of the theory of the descent of man from the monkey, thought they had found in this little blunt point on the auricle another reason for their belief; but these *defects* in the auricle have been shown by Ludwig Mayer, of Germany, to be the results of inflammation before birth, and therefore they are congenital. They are in fact remnants of the edge of the cartilage of the auricle, the greater portion of which has been eroded by disease, as above stated.

The Auditory Canal.—The auditory canal may be said to be a continuation inward of the trumpet, of which the auricle is the broad and flaring mouth

(Frontispiece, 14). The auditory canal is a passage one inch and a quarter long, averaging one-quarter of an inch in diameter, slightly narrower at its central part than at either end. It is composed one-third of cartilage and two-thirds of bone, and is lined throughout with skin, a continuation of that of the auricle, already considered. A general idea of its nature can be gained by consulting the Frontispiece. It is closed hermetically at its inner end by the drum-head, or *membrana tympani*. The skin of the auditory canal, besides the usual elements of skin, viz., sebaceous, perspiratory, and hair glands, contains at its outer part, around its entire calibre, the ceruminous, or ear-wax glands. These are between one and two thousand in number, and resemble in their structure the sweat-glands; they are indeed what the anatomist calls modified sweat-glands. Their function is to secrete the wax of the ear, with which all are familiar. This substance is of the highest importance to the comfort and health of the auditory canal. So long as the outer end of the canal wall is smeared with this wax, the skin is free from itching, and the ear is comfortable. Its peculiarly glutinous and bitter nature is a protection against the incursion of insects, and it also prevents the growth of fungi, or mould, in the canal.

The Drum-Head, or the Membrana Tympani.—The drum-head, or *membrana tympani*, is that part

of the ear forming the partition between the external ear and the middle ear, or drum-cavity. The

Fig. II.—Outer Surface of the Drum-Head. Magnified about 3½ times.



1, The flaccid part of the drum-head; 2, Short process; 3, The back fold of the drum-head; 4, The anvil's long and descending limb shining through from behind the drum-membrane; 5, 5, The true membrane; 6, 6, 6, 6, Inner end of bony canal forming frame for drum-head; 7, The pyramid of light; 8, Lower part of the hammer; 9, The front fold of the drum-head.

drum-head is popularly called the drum; but this is not a strictly correct term to apply to it. It is really the outer wall of the drum. The latter name is applicable only to the cavity of the drum or middle ear.

The drum-head is almost circular, about a quarter of an inch in diameter, and 0·10 mm., or about $\frac{1}{250}$ in., in thickness, *i. e.* about as thin as fine gold-beaters' skin. It is composed of three distinct layers: 1. An outer one, of skin, a continuation of that lining the auditory canal; 2. A middle layer of fibrous tissue, the thickest of the three, and that on which the other layers are stretched; 3. The inner layer of mucous membrane, continuous with the mucous membrane lining the cavity of the drum. It is thus seen that the drum-head partakes of the structure of the external and of the middle ear. Running from above, downward and backward, in the central line of the drum-head, there is an opaque, white ridge. This is the first evidence we get by inspection of the chain of auditory bonelets connecting the drum-head with the drum-cavity, and finally with the internal ear, where the nerve lies. (Fig. II., 2–8.) This is the so-called handle of the hammer, one of the bonelets alluded to. This handle is firmly attached to the middle layer of the drum-head, and is thus all the more likely to move to and fro with every motion of the drum-head. The further advantage of this intimate connection between the hammer-handle and the drum-head will be shown when considering the mechanism of the auditory bones as a whole. The drum-head is situated at the bottom of the external auditory canal, in a bony ring of its own, and is therefore

about an inch and a quarter from the mouth of the auditory canal at the auricle.

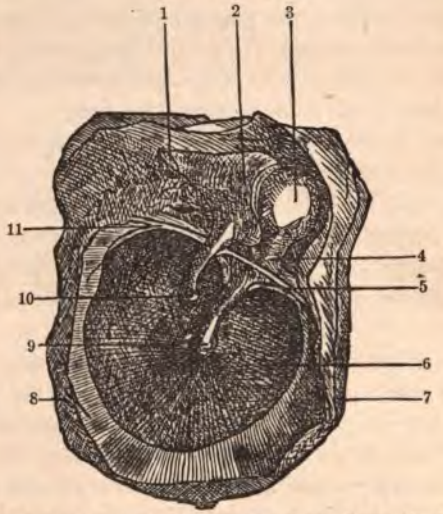
When the healthy drum-head is viewed in its proper position, there are several features which at once attract attention. It is nearly circular in shape; it is of a delicate pearl or bluish color, excepting along the ridge marking the position of the handle of the hammer-bone, where it is decidedly whiter and opaque. It will also at once be noticed that the drum-head looks like a thin membrane stretched over a dark, or nearly dark, cavity. Such indeed is the case, for the only light in the drum-cavity beyond, is transmitted to it through the translucent drum-head.

The surface of the drum-head is seen to be not only very smooth, but polished and lustrous. So marked is its lustre at the lower and front part, between the tip of the ridge, alluded to as the handle of the hammer, and the circumference of the drum-head, that at this point, owing to the concavity of the membrane and its position in the axis of the auditory canal, a bright, cone-shaped reflection of light is seen running in one of the diameters of the membrane. (Fig. II.,7.) This has been called the "cone of light," and should be found in ears which have a drum-head of normal position and lustre.

The handle of the hammer alluded to above, is more prominent at its upper part than anywhere else on the drum-head. This prominence has been named

the *short process*, and plays a conspicuous part in the plotting out of the membrane by anatomists. (Fig. II., 2.) It looks not unlike the head of a pimple.

Fig. III.— Inner Surface of Drum-Head of Man. Magnified about 3½ times.



1, Short limb of anvil, attached to back part of outer bony wall of tympan's cavity; 2, Body of anvil-bone; 3, Head of hammer-bone; 4, Neck of hammer; 5-11, Chorda tympani nerve This marks also the boundary line of the pockets and folds of drum-head. The latter are shown in Fig. 2, at 1 and 5. 6, Front part of drum-membrane; 7-8, Bony frame around drum-head; 9, The lower part of handle of hammer-bone; 10, Lower part of long limb of anvil-bone. To the point 10, the head of the stirrup is attached.

From it, backward and forward, to the circumference, pass two prominent ridges, or folds in the membrane. (Fig. II., 3 and 9.) These are called the folds of the drum-head, and serve as the upper boundary of the membrane proper. There is a part of the membrane above them, which contains no fibrous tissue, like the middle layer of the drum-head proper, and to this part the name of the flaccid membrane is given. (Fig. II., 1.) Directly behind lies the neck and head of the hammer; never visible, however, in health.

The line of these folds is nearly the line of support for the leverage exercised by the hammer bonelet. The handle is the lower arm of this lever, and the neck and head of the hammer, the part not visible from without (see Fig. III., 3 and 4), is the upper arm. The axial line is an important part in the function of the entire chain of bonelets, yet to be described. A general idea of the topography of the drum-head, as marked out by these parts just alluded to, is gained by consulting Figs. II. and III.

The Middle Ear.—We have now come to the consideration of the anatomy of the middle ear, the seat of most of the diseases of the organ of hearing. As has been stated, page 11, the middle ear is composed of the drum-cavity and its important adjuncts—the Eustachian tube and the mastoid cells. Of these three parts, the drum-cavity is the most delicate and complicated in structure, and most liable to disease.

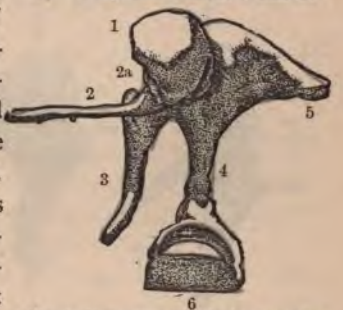
We shall therefore give our first attention to its structure and functions.

Drum-Cavity. — For the sake of convenience and accuracy, the drum-cavity may be said to be enclosed by four walls, a roof, and a floor. The four walls are named the front, the back, the inner, and the outer. Its most important contents are the three auditory ossicles, or the small bones of the ear. This cavity is about half an inch in height and width, and from the twelfth to the sixth of an inch deep, measuring from within outward, and lies of course just behind the drum-head. It is lined with mucous membrane, a continuation of that of the nose, throat, and Eustachian tube, which is reflected over the contents of the cavity. This is the drum proper, and the only part of the ear to which the term drum or tympanum should be applied. But great confusion constantly arises from applying the name "drum" to the drum-head, or the membrana tympani.

Auditory Bonelets. — The auditory bonelets, or ossicles, as they are more usually called, are *three* in number: The hammer, or *malleus;* the anvil, or *incus;* and the stirrup, or *stapes*, named from their resemblance in shape to these implements. They form the so-called "chain of bones" of the ear. In passing into the drum from without, the first little bone one comes to is the hammer, which is the largest of the three.

It is divided into a head, neck, and handle. It is about a quarter of an inch long; the handle forms about half of this length, and the head is about the one-eighth of an inch thick. Its general appearance and various parts, magnified about four times, may be learned from Fig. IV. It is the handle of this small bone which is inserted into the drum-head, and holds, as it were, the latter taut. (Fig. II., 8–2.)

Fig. IV. — The three Bones of Hearing of the right ear in their natural position, seen from within. Magnified about 4 times.



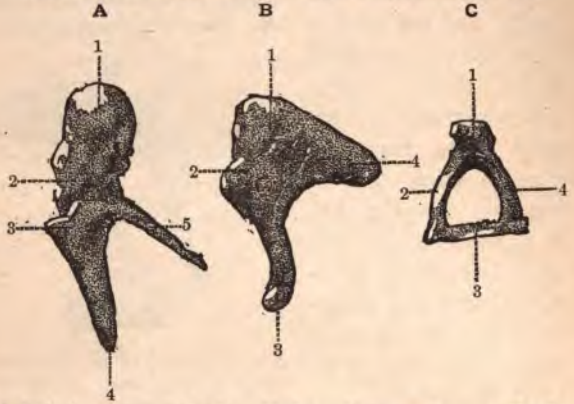
1, Head of hammer; 2 is the long process, and 2a the short process, of the hammer; 3, The handle of the hammer; 4, The long limb of the anvil; 5, Its short limb; 6, The stirrup.

The hammer, besides this attachment to the drum-head, is held in position by ligaments which fasten it to the roof and the outer wall of the drum-cavity.

Next in order, passing inward, comes the anvil. This small bone is divided into a body and two processes or limbs — a long and a short one. (Fig. IV., 4, 5.) The former is called also the descending limb, while the shorter one is sometimes called the horizontal limb. It, too, like the hammer, is held to the upper and posterior wall of the tympanic cavity by liga-

ments. This bone is a trifle smaller than the hammer, to which it is joined as seen in Fig. IV. This

Fig. V.—The Bones of Hearing. Magnified 4 times.



A. Right hammer. 1, Head; 2, Neck; 3, Short process; 3-4, Handle; 5, The long process.

B. Right anvil. 1, Body; 2, Joint surface for union with hammer (see Fig. IV.); 3, Long process or leg. The point 3 unites with the head of the stirrup; 4, Short process or leg, which is joined to the back part of the tympanic wall at 1, Fig. III.

C. Right stirrup. 1, Head; 2 and 4, The legs; 3, The foot-plate, which fits into the oval window.

joint has the peculiarity of unlocking, if the handle of the hammer is pulled outward; but if the handle of the hammer is pushed inward, this joint is only more firmly locked, and the hammer carries the anvil with it. This will be seen to be important in the

mechanism of the ossicles as conductors of sound vibrations inward to the inner ear.

The action of this joint has been likened to some watch-keys which wind the watch when turned in a certain direction, but when turned in the opposite way, the handle is unlocked from the barrel, and the watch remains unwound.

The innermost of the three ossicles is the stirrup, the smallest bone in the human body, its entire length being one-eighth of an inch. It is divided into a head, a neck, two legs, and a foot-plate. The head is a cup-shaped button, at the junction of the two legs, and is designed to receive a knob-like projection on the end of the anvil's long limb. (Fig. V., C, 1.) The two limbs of the stirrup are furrowed on the inner surface, which makes them lighter, but does not take from their strength. The foot-plate (Fig. IV., 6) is ovoid in shape, and fits accurately into the oval window of the labyrinth, where it is hermetically held by a fibrous packing. Thus, the connection between the outer ear and the drum-head, and the labyrinth and the nerve of hearing, is completed. It may aid the understanding to liken this chain of bones to a bridge, which thus connects the drum-head with the labyrinth and the auditory nerve. (*Frontispiece*, 7, 8, 9.)

This entire bridge, or chain of bones, moves as a whole in and out. It is this kind of oscillation, to and fro, on the part of the drum-head and the chain

of auditory bones, that causes the foot-plate of the stirrup to play backward and forward with minutest excursions, and it is this movement of the foot-plate that sets the water of the labyrinth into vibrations, which in turn impress the auditory nerve, and produce hearing.

Fig. VI. — View of the Left Tympanum, or Drum-Cavity, from above, after removal of the Roof. Magnified between 3 and 4 times. (Helmholtz.)



1, Entrance to Eustachian tube and the throat; 2 and 6, The chorda tympani nerve, marking also the boundary of the so-called pouches of the drum; 3, Front ligament of the hammer; 4, Supporting spine of bone; 4–5, External ligament of support of the hammer; 7, Attachment of the short limb of the anvil to the drum-cavity; 8, Ligament of support for latter; 9, Body of anvil-bone; 10, The stirrup muscle; 11, The head of the stirrup — rest of bone invisible from this point; 12, Joint between anvil and hammer; 13, Head of hammer; 14, The stretcher muscle of the drum, running from the Eustachian tube across the drum-cavity to the hammer.

Boundaries of the Drum. — The roof of the drum-cavity is the boundary between the brain and the drum. This partition is very thin, sometimes it has chinks in it; hence disease of the drum-cavity is liable to pass into the brain and prove fatal.

Let the reader now imagine a right drum-cavity opened before him, by the removal of its roof.

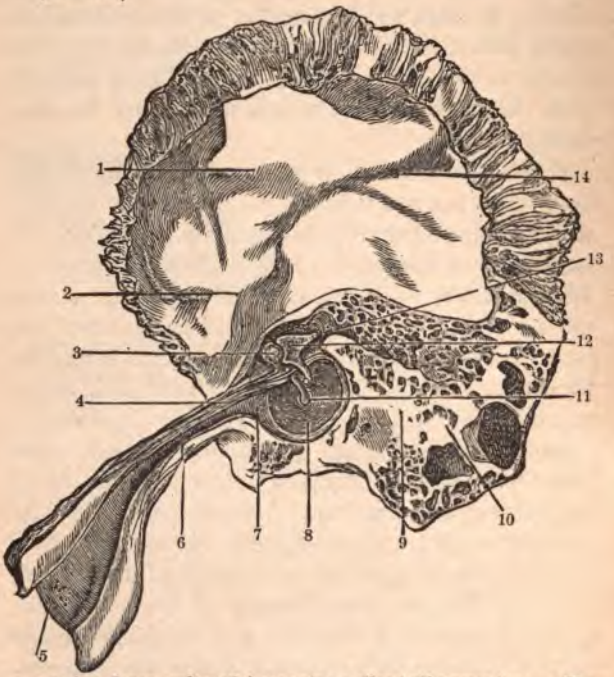
The anterior or front wall, *i. e.* the wall nearest the throat, is chiefly remarkable for the orifice connecting it with the Eusta-

chian tube (Fig. VI. 1), called the tympanic, or drum-mouth of the Eustachian tube. There is also on its upper and inner part a little pyramidal elevation (Fig. VI. 14), through which plays the thread-like tendon of the muscle called the *tensor tympani*, the stretcher of the drum. This muscle is a delicate offshoot from the muscles of the palate, which work the Eustachian tube.

When these muscles, in passing up from the palate, have nearly reached the bony portion of the tube, *i. e.* the beginning of the tympanic cavity, they stop, but send on to the drum-cavity a small and slender muscle. This muscle, a little over an inch long, lies in a narrow bony canal of its own, on the upper part of the bony portion of the Eustachian tube, until it reaches the drum-cavity. Here the tympanic end of this delicate bony canal is narrowed and extended free into the cavity of the drum, forming the aforesaid pyramidal elevation. Through this, as a fulcrum, the tendon of the "stretcher of the drum" (*tensor tympani*) passes, nearly at a right angle, to the drum-head, where it is inserted into the back part of the neck of the hammer bonelet. (Fig. III., near line 5.) It can now be understood how any contraction in the delicate muscle just named, can be communicated to the hammer-bone, and by it to the drum-head.

The back wall, like the front, is narrow. In its upper part is the opening which connects the drum-

Fig. VII.—View of Inner Surface of Right Temporal Bone, and of the Inner Surface of Drum-Head, also of the Eustachian Tube and Mastoid Cells in Section. Natural size, (Politzer.)



1, 2, and 14, Inner surface of the temple; 3, Head of hammer-bone; 4, The tensor tympani, or stretcher-muscle of the drum; 5, Mouth of Eustachian tube, in throat; 6, The narrow isthmus of the tube, and, 7, its opening into the drum-cavity; 8, Drum-head; 9, 10, Mastoid cells; 11, Handle of hammer; 12, Anvil-bone; 13, Short limb of latter, attached to outer bony wall of drum-cavity. This also marks entrance to mastoid cells, 9, 10.

cavity with the mastoid cells. (Fig. VI., 8, also Fig. VII., 13.)

It is thus shown how the drum-cavity communicates, in front, with the Eustachian tube and throat, and behind with the mastoid cells, and it can also be seen that air conveyed by the Eustachian tube to the drum-cavity is also conveyed to the mastoid cells.

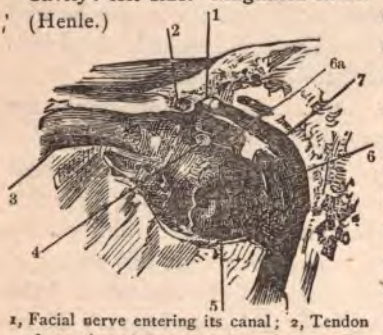
Wider and more intricate in their topography are the outer and inner tympanic walls.

The *outer* wall of the drum-cavity is composed mainly of the drum-head. The bony ring in which the drum-head is stretched, forms the limit of the outer wall. In close connection with this wall, *i. e.* the drum-head, is the handle of the hammer and the chorda tympani nerve. (Fig. III., 9 and 5–11.) There are also on the upper and inner part of this outer wall certain folds of the mucous membrane, around the chorda tympani nerve, called the pouches of the drum-head. That fold in front of the hammer, between it and the circumference of the drum-head, is called the anterior pouch, (Fig. II., 9;) the fold behind the hammer is the posterior fold or pouch, and is the larger of the two. (Fig. II., 3.)

The *inner* wall demands close examination in order to understand its divisions. On this wall is a convexity, called the promontory, which is caused by the outward projection of the lower turn of the cochlea, yet to be described. (Fig. VIII., 5.) This eminence

is usually seen through the drum-head, as a pale-yellowish spot. Here the inner and outer walls are closest together, and at times touch each other. Just above the promontory is the oval window, (Fig. VIII., 4,) which receives the foot-plate of the stirrup, and behind and below the promontory is the round window. From the head of the stirrup runs the stirrup-muscle. (Fig. VIII., 6, 6a.)

Fig. VIII. — Inner Wall of Drum-Cavity: left side. Magnified twice. (Henle.)



1, Facial nerve entering its canal; 2, Tendon of stretcher of the drum cut across; 3, Eustachian tube; 4, The stirrup-bone in oval window; 5, The promontory under which, in dark cavity, is round window; 6, The stirrup-muscle; 6a, its tendon; 7, The canal in which the facial nerve runs.

The long diameter of the little oval window is 3 mm., or about $\frac{1}{8}$ of an inch, and its short diameter about $\frac{1}{16}$ of an inch. The diameter of the still smaller round window is a trifle more than $\frac{1}{16}$ of an inch. A ridge begins above the oval window, and curves backward and downward, behind the promontory and the round window. This ridge is not only the hindmost boundary of the inner wall of the tympanum, but marks the course of the canal conveying the facial nerve through the drum-cavity to the face. (Fig. VIII., 7.)

It is thus seen how inflammations of the ear may extend to this nerve, and produce, as they often do, paralysis of the face.

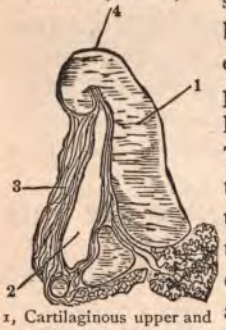
The *floor* of the tympanic cavity is merely a groove, where the inner and outer walls of the drum-cavity come together.

We have thus sketched the anatomy of the tympanum or drum-cavity, the most important part of the middle ear. It will now be necessary to briefly give the prominent features of the anatomy of the Eustachian tube and of the mastoid cells, which form the remaining parts of the middle ear.

Eustachian Tube.—The Eustachian tube is the only normal aerial communication between the throat and the drum-cavity. It opens into the upper and back part of the throat, in that part of the latter called the *pharynx* (*i. e.* the part above the palate), a little above the floor of the nostrils. It passes upward, outward, and backward to the cavity of the drum, forming an angle of 40° with the horizon, and an angle of 135° with the external auditory canal. The mouth of this tube in the pharynx is wide, but from this point the tube narrows rapidly to what is called the *isthmus*, from which it widens again to form the tympanic mouth. (Frontispiece, 11, 12, 13.) The entire length of the Eustachian tube is a little more than one inch. The mouth of it, in the pharynx, is about $\frac{3}{8}$ of an inch high and $\frac{3}{16}$ of an inch in width, the isthmus is $\frac{1}{16}$ of an inch in width,

and the tympanic mouth is $\frac{3}{16}$ of an inch in height, and about $\frac{2}{16}$ of an inch wide. About $\frac{2}{3}$ of the tube is cartilaginous, the other third being of bone. (Fig. VII., 6–7.) A cross section of the bony portion would be circular in outline, while a cross section of the cartilaginous portion would resemble a shepherd's crook. (Fig. IX., 1–4.) This crook-shaped wall of cartilage is really the posterior and upper wall of the tube, the anterior and lower wall or side of the tube being composed of a membranous tissue to which muscles are fastened. It is the action of these muscles which opens the tube, by drawing the front wall away from the back wall. It is also observed, by consulting Fig. IX., that the calibre of this tube is a linear one, and not circular, as in the bony portion. It is an offshoot of these muscles which forms the stretcher-muscle of the drum (tensor tympani), alluded to on p. 27.

Fig. IX.—Transverse Section through the Eustachian Tube. Magnified about 3 times. (Henle.)



1, Cartilaginous upper and back wall; 2, The cavity of the tube proper; 3, The front wall composed of muscle; 4, The hook-shaped part of the upper wall, curving forward to join with the muscular wall. This hook-shaped part moves with the muscles with every act of swallowing, and aids in widening the cavity, 2, through which air passes to the inside of the drum.

Mastoid Cells. — The remaining division of the middle ear claiming our notice, is the mastoid portion of the temporal bone containing the mastoid cells.

Behind the ear, as any one can feel on himself, is a rounded prominence. This is the mastoid portion now to be considered, and its interior arrangement may be seen by referring to Fig. VII., 9, 10, and 13. It communicates with the drum-cavity, as already stated (p. 27), which arrangement may be better understood by referring to Fig. VII. The cavity of the mastoid bone is filled with a set of spongy bone-cells, all lined with the same mucous membrane, lining the drum-cavity, which, of course, renders them liable to partake in the diseases of the cavity of the drum. Thus the mastoid cells are seen to be in intimate relation with the cavity of the drum, being in direct anatomical and aerial communication.

The Internal Ear.— By the internal ear is meant the labyrinth and those portions of the auditory nerve directly connected with it.

The *labyrinth* is composed of the vestibule, the central portion or chamber, the cochlea or snail-shell in front, and the semicircular canals behind. It is a hollow, bony cavity, the general shape of which may be seen in Fig. X. Allusion has already been made to the oval window in the inner wall of the

drum-cavity, into which fits the foot-plate of the stirrup-bone. This window opens into the vestibule, and may be looked upon as the chief connection between the drum-cavity and the labyrinth. (Fig. X., 6.) The vestibule must be regarded as the central portion of the labyrinth, for from it, in front, passes the coiled tube called the cochlea (Fig. X., 7), and the three peculiar tubes, semicircular in shape, are connected with it behind. (Fig. X., 1, 2, 3, and 4.) The cavity of the vestibule is egg-shaped, or slightly pear-shaped, its dimensions being about $\frac{1}{8}$ of an inch from within outward, and a little more than $\frac{3}{16}$ of an inch measured from front to back. Its four walls tend to unite in front, at the part of the pear-shaped cavity, where the cochlea begins. This latter part of the labyrinth may be described as a bony canal twisted two and a half times about a bony pillar. (Fig. XI.) This canal is partially divided into

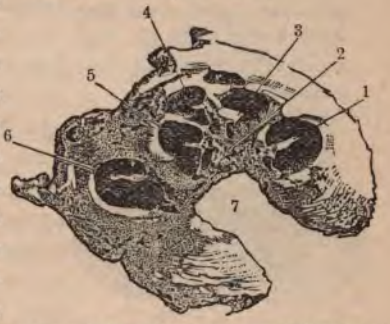
Fig. X.— The Bony Shell of the Right Labyrinth. Magnified 2½ times.



1, So-called ampullar end of the superior semicircular canal; 2, Horizontal semicircular canal; 3, Junction of superior and posterior semicircular canals; 4, The posterior semicircular canal; 5, Round window; 6, Oval window; 7, Cochlea, or snail-shell.

two smaller canals by a bony shelf running throughout its entire length. (Fig. XI., 1, 3, 4, 5, and 6.) This partition is completed by a membrane. (See Fig. XIII., 8–5.)

Fig. XI.— Cochlea laid open. Magnified 4 times. (Rüdinger.)



1, 3, 4, 5, 6, Bony shelf forming part of the partition between the two passageways of the cochlear canal; 4, Represents also the hook-like end of this spiral shelf as it winds around the bony pillar, 2; 7, Point of entrance of the hearing nerve into the cochlea.

The canal of the cochlea is divided thus into two passages or stairways. If one could pass by means of the upper one from the vestibule, he would emerge at last, by the lower one, at the drum-cavity, through the round window. The latter is closed by a membrane.

When the fluid in the vestibule and labyrinth is compressed by the pressure inward of the foot-plate of the stirrup, the labyrinth-liquid finds a point of relief at the round window in the slight yielding in the membrane which then takes place.

The *semicircular canals* are three in number, and communicate with the back part of the vestibule by

means of *five* openings. We would naturally expect six openings for three semicircular tubes, but two of them, the upper and the hinder one, unite in a common tube (Fig. X., 3) just before they reach the wall of the vestibule. This completes the brief sketch of the bony shell of the labyrinth. The latter is hollow, and in its perfect condition is filled with water, in which are soft parts, yet to be described, resembling in outline and shape the general shape of the bony box in which they are placed. They may be termed membranous, hollow casts of the labyrinth — they are termed in anatomy the membranous labyrinth — and contain in their soft and delicate cavities the still more delicate nerve-branches supplied to the internal ear by the hearing nerve. The latter, as it nears the labyrinth, on the inner wall of the vestibule, passes through a sieve-like spot into the labyrinth, and is divided into two great

Fig. XII.—The Bony Cochlea laid open, showing the Soft Parts within. Magnified about 2½ times. (Modified from Hagen.)



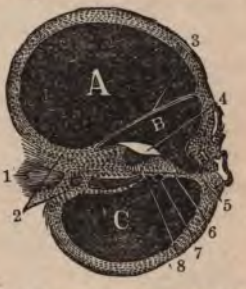
1, Ampullar enlargement on superior semicircular canal; 2, Vestibular nerve-branches going to 8, the elliptic sac, and the ampullar enlargements at 1 and 10; 3 and 6, Bony shelf of the cochlea on which lies the fringe-like nerve-filaments; 4 and 5, The basilar membrane on which lies the organ of Corti; 7, The round sac; 9, The ampulla of the posterior semicircular canal.

branches, viz., the cochlear branch and the vestibular branch. (Fig. XII.)

Membranous Labyrinth.— Respecting the soft parts of the labyrinth, it may be said, in brief, that in the vestibule are found two little sacs, the round and the elliptic. (Fig. XII., 7 and 8.) The latter is the larger, and with it unite the membranous semicircular canals. It is joined to the round sac by means of a V-shaped tube. The round sac unites with the cochlea. Thus it is seen that the membranous labyrinth, like the bony case containing it, is, in reality, one cavity. It not only lies in water, but is filled with water. This labyrinth-fluid is part of the natural water of the brain and skull-cavity.

The vestibular nerve supplies all the soft parts in the vestibule and membranous semicircular canals (Fig.

Fig. XIII. — Section of Cochlear Canal in Profile. Magnified 20 times. (Modified from Hagen.)



1, The nerve of hearing; 2, The bony shelf through which the nerve passes on its way to Corti's organ; A, Vestibular stairway, in its natural condition, filled with water. Through this, impressions pass from the vestibule to the organ of Corti, 8, 7, and 6; B, The cochlear duct, also filled with water, in which the organ of Corti lies; C, The tympanic stairway, ending at round window; 3, The membrane of Reissner; 4, Corti's membrane; 5, Attachment of basilar membrane to outer wall of cochlea; 7, Blood-vessel cut across.

XII., 2), and the cochlear nerve supplies the cochlea. (Enters at 7, in Fig. XI.) It would be of great interest to the reader to have the nerve briefly traced in its distribution to the cochlea.

Cochlear Nerve and Corti's Organ.—The cochlear nerve, after pushing its way into the bony pillar around which the cochlear canal is twisted, divides into a number of branches, which, emerging finally on the bony shelf of the cochlea (Fig. XI., 1, 3, 4, 5, and 6), are spread out on it in a fringe-like manner. (Fig. XII., 6.) In order to understand this, we shall simply trace one filament or nerve-thread on its way from the sieve-like spot through this bony pillar to the organ of Corti — its final destination. (Fig. XIII., 1, 2, 6, 7, and 8.) The organ of Corti may be called a supporting frame-work, consisting of two pillars placed on the membranous partition between the two passage-ways in the cochlea. (Fig. XIV., 8 and 9.) They lean towards each other and are united above, thus forming what is known as Corti's arch. This arch holds up a delicate net-work, in the meshes of which is fastened, both inside and outside of the arch, a series of cells, with fine hairs on their upper ends. To these cells the nerve-threads finally pass and are attached. (Fig. XIV., 7 and 10.) Up through the bony pillar, out through the bony shelf to near its free lip, through this to the arch of Corti, from

one side of this to the other, beyond it to the hair cells and into the latter, pass the nerve-threads.

Fig. XIV.—Diagramatic Representation of Corti's Organ, viewed in Profile. Magnified between 300 and 400 times. (Modified and reduced from Hagen.)



1, The base of the inner-haired cells: auditory nerve passing between them; 2, Section of blood-vessel; 3 and 5, The basilar membrane, which unites the edge of the bony shelf at 1, with the outer wall of the cochlea at 6, thus dividing the cochlear canal into A, The vestibular scala or stairway, and C, The tympanic stairway; B, Represents the so-called cochlear duct, separated from A by a membrane 13, named after Reissner, its discoverer. See also Fig. XIII., A, B, and C; 8. The outer pillar of Corti, leaning against 9, the inner pillar, forming Corti's arch; 4, Outer-haired cells, receiving nerve-filaments from 14, the nerve of hearing; 7, Upper ends of haired cells where the acoustic hairs are found; 10, Upper ends of inner-haired cells; 11, Corti's membrane; 12, Upper lip of bony shelf. The nerve of hearing, 14, runs through lower part of shelf, and comes out at the lower lip at 1. Corti's organ may be said to lie between the lines 5 and 12.

There are about three thousand of these organs or arches of Corti in the human ear, each one of which,

it is with good reason supposed, is specially tuned so as to respond to the various sounds in the musical scale.

Those impressions which we call sound, and which this delicate structure is intended to receive, will call for a short consideration in the next chapter, in which place, also, there will be given some account of the more general functions of various parts of the organ of hearing.

CHAPTER II.

PHYSICS AND PHYSIOLOGY OF SOUND AND HEARING.

Physics and Physiology of Sound.

SOUND is motion imparted to the auditory nerve This motion is usually conveyed by undulations in the air. A shock from a sounding body, communicated to the atmosphere around it, passes by a wave of undulation away from it, on all sides which are free, as the waves ripple the surface of a pool after a pebble has been thrown in. Sound moves at the rate of 1090 ft. per second, in air, at the freezing point. The velocity increases two ft. a second for each increase of 2° C. in the temperature. The water must represent the atmosphere, the pebble the source of sound in the vibrating body, the ripples on the surface of the pond the sound-waves in the air, and the shore of the pool, the ear or the receptive point of the sound-waves. The perception by the ear of this movement in the air, *i. e.* of these vibrations, as they are called, is hearing.

Intensity of sound depends on the breadth of these waves; *Pitch* depends upon their number in a second, and *Quality*, clang-tint, or timbre, depends upon the peculiarity and the manner of the occurrence of the sound. Every sound is composed of a number of subordinate or partial tones, as they are called, just as ordinary light is composed of several colors. It is the number and strength of these partial tones that makes the difference in sounds. It is in these that one voice differs from another. The first partial tone is the fundamental note; the others are the "*over-tones*," or the harmonics.

Ordinary musical tones, as notes on the piano and organ, vary from 33 vibrations to 3960 vibrations, *i. e.* rapid motions backward and forward, in a second. Some pianos are made so as to give out notes with as many as 4224 vibrations in a second. The piccolo, a kind of flute, emits a shrill note of 4752 vibrations a second. These are the ordinary notes used in music; but the human ear distinguishes as music a note with as few vibrations as 20, and as many as 38,000 in a second. The higher notes, however, are more or less painful to the ear, since they set up such powerful vibrations in the air of the auditory canal.

Echo is the throwing back of sound-waves to their source. To recur again to the surface of the pond, as the waves reach the bank, it is observed that some

of them appear to go back towards the point of starting, thus representing echo.

When these sound-waves occur with regular and even intervals between them, we call such sound musical. But when they occur in great irregularity, they produce discord or *noise*.

Physiology of Hearing.— Having thus sketched the movements in the air we call sound-waves, let us follow a wave of sound from its source into the ear and brain, where it is interpreted as sound. Thus we shall learn what hearing is.

When a wave of sound reaches the side of the head part of it is taken up by the auricle, and directed more accurately into the external auditory canal. Passing down this at the rate of 1090 ft. and more per second, at ordinary temperatures, the wave reaches the drum-head, which is thrown into a to-and-fro motion by the wave. The drum-head imparts this motion to the malleus, and by it to the other ossicles, thus causing the entire chain to move in and out, but not to vibrate in the sense that a violin-string vibrates. They assume rather what is known as a pendulum-like movement or oscillation.

By this means the little foot-plate of the stirrup-bone makes short in-and-out movements or excursions in the oval window. This, as we already know, opens into the vestibule. This movement on the part of the stirrup bonelet is communicated to the water

of the labyrinth. Through this fluid, the impressions of the sound-wave on the chain of bones is conveyed to the soft parts of the labyrinth, where the nerve lies; and it is the perception of this movement in the water of the labyrinth, by the nerve-threads and the brain, which constitutes hearing.

Physiology of the Auricle.— In the lower mammals the auricle acts as a collector of sound. In them the auricle is supplied with well-developed muscles, and is consequently very movable, as can be seen by watching the horse, the cow, or the rabbit. In these animals the auricle is movable both forward and backward, so as to enable them to catch sounds both from before and behind, which is a characteristic of animals that are grass-eaters, and likely to be pursued by flesh-eating beasts. This function of the auricle in them is a protective one, as it enables them to be on the alert for their enemies. The auricle in the flesh-eaters, on the other hand, is by nature pointed forward rather than backward, and is more easily kept by them in that position than in any other. This, of course, enables them to hear their prey, which is, as a rule, ahead of them, and which they are in hot pursuit of. In aquatic mammals the auricle is very small, but can be drawn firmly and tightly inward, so as to keep out water while they swim. In man, however, the auricle is immovable, being unnecessary as an adjustable collector of sound, yet not altogether

free from service, since, by its shallow, trumpet-mouth shape, it acts as a collector or strengthener of some of the weaker sounds which fall upon it, and without it would be lost to the human ear. While it has no part in the quantitative conveyance of sound, it has a decided effect on the qualitative sensation of sound, as perceived by the human auditory nerve. This fact any one can convince himself of when in the presence of a multitude of sounds, as, for example, by the sea-side, near escaping steam, or in a grove with rustling leaves. When in such circumstances, let the auricle be pressed gently forward or firmly backward against the side of the head. In the first instance, the sounds about the experimenter will seem fuller and deeper, and hence the deaf man instinctively puts his hand around and behind the auricle to enable him to hear all sounds better. In the second instance, the sounds of a deeper quality will seem to vanish, or be quieted, while the fainter ones, or those of higher pitch, will become more prominent. A further discussion or explanation of this point would involve a consideration of acoustics not in place here. It will therefore be sufficient to say that this is simply the result of the composite nature of such sounds as have been named above, and of many others too numerous to mention, and of the power the auricle has by nature to strengthen by resonance the component or "partial" tones in any sound.

Auditory Canal.—The auditory canal represents the tube of the trumpet, of which the auricle is the mouth. Its length, with the depth of the auricle, makes the external ear just the proper length or depth to resound to the more important and ordinary sounds of the human voice, as we hear it in every-day intercourse.

Aside from the resonant functions, the auditory canal has the power to expel any surplus ear-wax which may accumulate in it. As already shown, the glands which pour out this wax lie near the mouth of the passage. From that point, inward, it is slightly up-hill on the floor of the canal, because the shape of the canal is that of two truncated cones placed together at the point where their apices are cut off. This makes the mouth of the canal, and the inner end where the drum-head is stretched, the widest, while the middle of the canal is the narrowest part. From this point, therefore, the outer part of the canal inclines outward and the inner part inclines inward, or down-hill towards the drum. A ball of wax, if let alone, would naturally roll out of the ear, so long as it is in the outer end of the canal. And as it is formed there, it will not pass beyond the isthmus of the canal unless forced artificially inward. Another reason why ear-wax will naturally come out of the ear rather than remain in it, is because the skin of the drum-head and the auditory canal grows

outward, and tends to carry dirt and wax with it (just as the finger-nail grows and carries with it a spot or blemish), until at last the ear-wax, etc., appears at the mouth of the canal. But this process of nature is constantly interfered with by useless endeavors to swab and cleanse the ear.

Membrana Tympani, or Drum-Head.—The function of the membrana tympani is to collect sound-waves, transmit their impulses to the chain of little ear-bones, and support and keep in proper position the malleus or hammer-bone, and by that means the entire chain of bones, so that they will swing easily, like a miniature pendulum. Another function is to protect the mucous membrane lining the drum from the effects of the air.

A general idea of its function as a sound collector has been alluded to on p. 18, as well as the transmission of the impulse of the sound-wave by the chain of three bonelets to the vestibule and the auditory nerve.

If the membrana tympani is pressed too far either inward or outward, the chain of bonelets cannot swing properly, and hence sound cannot be transmitted; because, if the drum-head is pressed inward, the bones are pressed upon each other, and are so locked as not to be able to oscillate freely. If, on the other hand, the drum-head is forced outward, the malleus is carried outward, is thus partially unlocked

from the next bone, the anvil; and the chain being thus broken, sounds are not transmitted. In either condition, the conducting apparatus is said to be out of equilibrium. One of the greatest evils in a large perforation of the drum is the loss of outward traction the chain of bones thus sustains. That is, the balance of power between the drum-membrane and the stretcher-muscle of the drum being destroyed, the latter drags the chain of bones too far inward. They are then unduly locked on each other, and their swinging function altered, so that hearing is impaired.

When the drum-head is perforated, the mucous membrane of the middle ear is directly exposed to the external air. To protect this is one of the greatest functions of the drum-membrane. So evident is this, that many cases of aural discharge and deafness are relieved, and the drum-membrane aided in healing, by simply covering the perforation with a paper disk, after the suggestion of Dr. C. J. Blake, of Boston, or by protecting it with a little pellet of cotton.

The intact drum-membrane effectually prevents the entrance of anything like an insect into the head. Hence, when a foreign substance gets into the ear, it is foolish to become alarmed with the idea that it may penetrate further and pass into the brain. This it cannot do, for the drum-head is stretched across

the inner end of the canal to prevent such an occurrence.

If the membrane is perforated, then a substance in the canal might pass into the drum-cavity, but not into the brain; for that is an impossibility, as the brain lies inside the bony case of the skull. As we shall show further on, when disease of the ear eats into and destroys the bony partition which separates the ear-cavity from the brain, then the latter may become diseased in consequence of the original disease in the ear.

Tympanic Cavity.—The chief physiological function of the tympanic, or drum-cavity, is to act as an air-chamber, over one side of which the drum-head is stretched. This function of the drum can be clearly understood by recalling the structure of the drum of the musician. In both cases we find a membrane stretched over a hollow box, to which the air must have free access in order to enable the membrane or "head" to vibrate properly. In the musical instrument this free supply of air is kept up by a little hole in one side of the drum, and in the human ear-drum this air-supply is effected by means of the Eustachian tube. This conveys air to the tympanum, as will be shown further on. Hence, if this air-supply is taken away from the drum-cavity of the ear, by closure of the Eustachian tube, the air in the cavity soon becomes absorbed, a vacuum is formed in the drum, and

the drum-head is of course forced inward by the pressure of the external air. As has already been shown, this causes a locking of the auditory bonelets, and deafness ensues. (P. 47.) When considering the diseases of the ear, the bad effects of this vacuum in the drum will be further alluded to.

Eustachian Tube.— Every act of swallowing draws the front wall of the Eustachian tube from the back wall, and thus opens the tube. Air, of course, then passes into the drum-cavity, and thus a constant and even pressure of air is maintained on both sides of the drum-head. Were this not so, the air in the drum would be gradually absorbed, and the air on the outside of the drum-head would press the latter so far and so firmly inward as to impede its vibrations. This is the case when the tube is temporarily closed from any cause, and it is such a closure that is a common cause of deafness.

In children, a sudden closure of the Eustachian tube, and the consequent want in proper ventilation of the drum-cavity, causes earache and deafness by the undue inward pressure thus induced in the drum-head.

Every one knows that a membrane tightly stretched over a preserving jar will sink in if the air becomes exhausted from the under side. It is just the same state of affairs in the drum, if air is exhausted from the inner side of the drum-head. Hence the pain

and impeded hearing in such cases. The Eustachian tube acts like a safety-valve in cases where the drum-head is forced suddenly inward by the concussion of a blow or an explosion. The air behind the drum-head is forced into the tube, and even into the throat, thus allowing the drum-head to give enough to save it from rupture. Could it not then recoil, the resistance it would offer to the force of the blow would cause it to burst.

Mastoid Cells.— The benefits of the close connection between the drum-cavity and the mastoid cells (p. 29) can be best appreciated by a consideration of some of the facts pertaining to the physiology of the middle ear. It is a well-established fact in physics, that sound-waves will produce the greatest effect when, in the middle ear, the following three conditions are maintained:

1. The Eustachian tube must remain shut most of the time.

2. It must, however, be opened sometimes for purposes of ventilation; and this it is at every act of swallowing.

3. The cavity of the drum — the tympanum — must be in communication with large, irregular air-cavities, and this is gained by its aforesaid connection with the irregular, spongy cells of the mastoid bone.

This is a very important aid to the ear in hearing deep tones, for, in order that the tympanum may

properly receive the latter, it must have depth and capacity; therefore the tympanic cavity is in connection with the cavities of the mastoid cells. The beauty of this arrangement is better seen, when it is known that a larger drum-cavity, with regular outline and form, would be useless from its great resonance or echo. Hence, the irregular, spongy cavities of the mastoid bone, with which the drum is connected, appear to be necessary to accurate hearing.

Internal Ear.

When we come to the consideration of the physiology of the internal ear, it must be borne in mind that we are considering the mechanism of a water-containing cavity. It is practically a bony case filled with water, in which float, with slight attachments, the membranous parts of the internal ear or labyrinth. (See p. 36.)

The general mechanism of this part of the ear may be understood by likening the labyrinth to a perfectly water-tight keg lying on its side. On the side of the barrel towards us, we shall find an oval hole hermetically closed by a leather patch, and on the head of the barrel, let us say to our right if we are examining the left ear, we shall find a round hole, also hermetically closed by a leather patch. At two points, then, in this water-containing case, we shall find spots which

would yield slightly to pressure, either from within or without, so that if one were pressed inward the other would give correspondingly in an outward direction. This is just what is found in the oval and round windows of the labyrinth. Pressure inward from the base of the stirrup-bone is communicated to the fluid of the labyrinth, which, however, would not be thrown into motion, were it not possible for the labyrinth fluid to recoil by means of the yielding of that part of the boundary of the labyrinth known as the membrane of the round window.

It becomes manifest, therefore, from this arrangement, that the physiological mechanism of the internal ear depends on certain movements in the fluid with which it is filled. Whether this is simply an in-and-out motion, or a series of undulations, is not known.

Vestibule and Semicircular Canals.—It has often been supposed by leading physiologists that we hear noises with the vestibule nerves, while music is heard by the delicate nerve-structures in the cochlea.

It would seem that all hearing is effected by means of vibratile hairs on peculiar cells in communication with the ends of the various nerve-branches which reach the internal ear. This theory is based on the observations of Hensen and Ranke, of Germany, upon certain marine animals with transparent bodies. Examination of these animals by the microscope re-

veals not only curious cells tufted with stiff hairs, in connection with the nervous structures of their internal ears, which cells resemble the haired cells found in the internal ear of man, but it has been also observed that these stiff hairs vibrate, some with one, and some with other musical notes, when the latter are sounded near them.

There is every probability, therefore, that the most sensitive parts of the internal ear are these stiff-haired cells, each one of which is probably endowed with power of responding to the various sounds and notes which fall on our ears. These cells are especially numerous in the cochlea, the entire arrangement of which seems to be to favor the support and protection of these wonderful and minute bodies. (Fig. XIV., 7.)

The physiology of the semicircular canals is not known. It is supposed, however, and with some very good reasons deduced from experiments by a number of eminent Germans and Frenchmen, that these canals are endowed with a peculiar sensibility as to the position of the head and body, and that in them resides, so to speak, the sense of equilibrium, or proper carriage of the body. Hence, when these canals are artificially wounded or destroyed in birds and other animals, they are no longer able to control the movements of the body when they attempt to fly or walk. There then ensue peculiar reeling and

falling symptoms, without loss of consciousness. Since, with certain positive signs of ear-disease in man, there ensue at times just such peculiar reelings and falls, without loss of consciousness, it is supposed that these canals, in such instances, are the seat of disease. In the present day, therefore, some physiologists speak of a sense of equilibrium, and place its seat in these peculiar canals in the back part of the labyrinth.

PART II.

The Chief Diseases and Injuries of the Ear, and the Avoidance of their Improper Treatment.

CHAPTER I.

DISEASES OF THE EXTERNAL EAR.

Diseases of the Auricle.

THE auricle is liable to frost-bites in very cold weather. Although this is not dangerous either to the hearing or the health of the individual, it is painful, and, in the end, it may be disfiguring. The latter result is brought about either by the contractions which ensue on healing, or by the formation of lumps of new cartilage or of chalk in the structure of the auricle. When the auricle is frost-bitten, it becomes very white and dead-looking. It is also very brittle and insensible. Great care must be taken not to break it, and also not to heat it too quickly. Gentle handling is, therefore, necessary

and heat must not be applied at all at first. A gentle chafing or rubbing with snow or ice will be the best way of restoring, *slowly*, the circulation of the blood to the frost-bitten part. If heat should be applied, instead of stimulation by cold or very moderately tepid water, sudden inflammation may set in, and the ear will be just as though it had been burnt instead of frozen. Apply cold until the skin of the frozen ear begins to have feeling in it once more; then the organ is safe.

A severe blow on the ear may break the cartilage of the auricle, or may so loosen the covering of the cartilage as to permit blood to get under it, and remain there until inflammation of a low form is set up, which will liberate the blood, but deform, disgustingly, an otherwise beautiful feature of the face. This distortion is sometimes seen in the pugilist and in the insane. In the latter class it may be brought about either by violence on the part of themselves, their attendants, or their companions in sorrow; or it may be, as is held by many high authorities, a spontaneous symptom of the disease which is usually attended with so much debility, weakening of the tissues of the body, and defective circulation of the blood, that the latter, as it were, bursts from its limits, not only in the brain, but on the surface of the body. It is also supposed that this blood tumor of the ear, when it forms spontaneously in the auricle of the

insane, is a diversion of the blood from the brain, and, as such, saves the life of the lunatic for the time being. In this view, the disease may be said to be an apoplexy of the auricle, occurring instead of an apoplexy of the brain.

Imperfect Development. — Sometimes individuals are born without auricles, or they may be born with several auricles, some of which may be unnaturally placed, as, for example, low down on the neck. Again, the auricle may be only partially formed; yet, with all these defects, the hearing may be good. The hearing is rarely affected in such cases, unless the defect of the auricle is found to extend to the auditory canal or deeper parts of the ear. There is also a rare inborn defect, in some cases, in which a small hole persists in front of the auricle, where the cheek joins the ear. This is called a fistula of the ear, and may communicate either with the throat or the cavity of the drum, or with both. It seems to have no effect on hearing, and it may heal up in after years.

Skin Diseases. — The auricle is liable to numerous diseases of the skin, as chafing, sunburn, slight redness or inflammation from contact with poisonous plants, erysipelas, eczema, boils, syphilitic eruptions, shingles, and cancer.

Although many of these demand very little treatment, or are easily cured, nevertheless none should be neglected, and of course the graver ones would

instantly obtain attention. In all cases, whatever is put on the auricle to cure its diseases, should be carefully kept from running into the ear. An application, simple so long as confined to the auricle, might irreparably injure the drum, if allowed to reach it, by running into the auditory canal.

Diseases of the Auditory Canal.

Foreign Bodies. — And this brings us, first, to the consideration of foreign bodies in the ear. It is quite a common thing for children to put various objects into their ears, in ignorant playfulness. As a rule, anything which they would or could get into their ears can be removed; but not easily by any member of the family, unless he have special skill. It may be said, for the comfort of friends and parents, that no bead, button, "spit-ball," bean, grain of wheat or maize, or any similar small, smooth object which a child could put into its ear, will do any harm, *if let alone* by all save one entirely conversant with the structure of the ear, and properly supplied with instruments for examination and treatment. If your child, therefore, gets any such foreign matter in its ear, rest assured such object has not gone beyond reach of surgical skill. The harm in such cases *usually* arises from the unskilful means resorted to, in haste and consternation, for its removal. Let it alone until it can be properly removed. It can do no harm

at the outset; it cannot reach the brain unless you push it there (see pp. 48, 49); but a careless grappling for a foreign object in the ear may force it still further inward, lacerate the auditory canal, and perforate the drum-head. The pain thus given to the patient is usually mistaken for pain caused by the presence of the foreign body in the ear, and only stimulates the ignorant manipulator to still further unskilful and excruciating treatment of the ear. Not only children, but even adults, have been subjected to this most injurious treatment. The writer observed, not long since, the case of a mechanic, thirty-five years old, who allowed his comrades to pick mud from his ear, where it had been splashed by a passing horse. A syringeful of warm water would have given the necessary relief. Instead of this, however, the man and his companions, uselessly frightened by the thought that a little mud was in his ear, began to pick at the ear with bits of wire and other equally unsuitable instruments. This caused intense pain, which was construed as a symptom of the need of still further probing, until the man's drum and all the little bones of his ear were completely scooped out, and his hearing destroyed forever.

On the other hand, children who have placed beans and beads in their ears, and have not said anything about their prank for fear of parental punishment, are living proofs of the comparative harmlessness of the

presence of such things in the ear. Of course such things may do harm, and should always be removed in time, and by the proper person; but they had better stay there forever, than that any one should meet with the experience of the mechanic narrated above.

The writer, while removing a plug of ear-wax from the ear of an intelligent woman, fifty-eight years old, was surprised to see a solid blue glass bead roll from the ear during the syringing. The patient assured him that, fifty years previous, she had played with such beads, but had not seen any like this one since that time, nor could she remember that she had put any of these beads in her ear. Yet she felt convinced that she had done so, and had forgotten the act. Without doubt such had been the case, and the bead had remained fifty years in her ear without even her knowledge. Gradually wax had accumulated around it, and this, by causing deafness, led her to apply for relief, which finally led to the removal of the lost bead. This is quoted to show how much worse the usual gross endeavor at removal is, than even letting the foreign object alone.

The simplest, softest, most agreeable, and usually the most successful way to try to remove a foreign body from the ear, is to gently force it out by syringing.

This method is applicable especially to insoluble and inanimate objects. Too long continued use of

the syringe, in cases of entrance of grains of corn or of beans into the ear, would soften and swell them. But a trial of this method should be given for a reasonable time in any case by any one who is not within reach of a physician.

Insects in the Ear.—Greater and immediate annoyances are occasioned both to adults and children by the entrance of insects into the ear. It happens now and then that flies, ants, bed-bugs, fleas, small roaches, and the like, get into the ear. Most commonly it is a fly that gets into the ears of children. This will cause great fright and considerable pain, and sometimes the peculiar irritation in the ear may produce a convulsion. It should be stated here that there is a branch of the pneumogastric nerve — the great nerve supplying the stomach and lungs — distributed to the auditory canal. It is therefore quite common to observe both vomiting and coughing as the result of irritation in the ear.

Adults sleeping on the floor, usually in the summer time, often experience intense annoyance and pain in the ear from an incursion of a roach or some smaller variety of the beetle tribe, so constantly found at that season of the year.

Here, both syringing and the use of sweet oil come into good service, since they will tend not only to smother, but to remove the offender.

Syringing the Ear.—A few directions respecting

this important manipulation should appear at this point. The first injunction is *never use cold water* in the syringe. A short, hard rubber syringe, such as is known in drug-stores as a male syringe, No. 2, is about the best kind for general use. This should move easily, *without jerks*. An ordinary finger-bowl may be employed not only to hold the warm water, but to catch the current as it returns from the ear. The patient can easily hold this vessel against his cheek during the syringing, unless it be an infant, when a large towel under the ear will catch the return current from the syringe.

The syringer should take the auricle at its upper-back edge, between two fingers, and draw it gently upward and backward, so as thus to straighten the cartilaginous part of the auditory canal, and facilitate the entrance of the water. The nozzle of the syringe, held close to the ear, should then be directed downward and forward, so as to best convey the water to the depth of the canal of the ear.

A few drops of warm sweet oil will often cause the insect to crawl out; if not, it will smother it, and the creature will float to the surface of the fluid, and can then be easily removed from the ear.

There are of course numerous diseases of the external auditory canal — the canal leading to the drum-head — which the non-professional reader could not understand if they were described here.

It will suffice, therefore, merely to state that boils and abscesses are common at this part of the ear, and are exceedingly painful; but it is impossible for the patient to know, from his pain, whether he is suffering from a boil, a larger abscess, or from a wider inflammation in the auditory canal, or whether his earache is caused by inflammation in the drum. As a general rule, if the ear is sensitive to touch, the disease lies in the external ear, and the pain seems nearer the surface of the body. If the pain is deep, and at the same time the external ear is comparatively free from sensitiveness to touch, it may be concluded that the disease is in the drum. But this is only a very imperfect guide, and must not be implicitly relied on. Rather let it lead to the consulting of a surgeon to clear up the doubts.

Boils and Fungi.—One of the most painful of ear-diseases is an attack of boils in the auditory canal, usually at that point where the auricle passes into the canal. Not uncommonly these are caused by the irritation in the canal set up by the growth of a microscopic vegetable parasite, the fungus Aspergillus. In many cases, however, it is not easy to say whether the fungus excited the boil, or whether the small particles of matter from the boil have supplied the soil most likely to cause this parasitic plant to grow in the auditory canal. Be this as it may, the presence of this parasite in the ear excites a stubborn and

intense inflammation in the organ, with earache and deafness. The usual recourse now is to pour oil or fatty matters into the ear, which, unfortunately for the patient, only feed the fungus, cause it to grow with renewed vigor, and the patient grows worse. Oils and fats should, as a rule, be kept from the ear, and most positively they should never be used if this parasitic fungus has attacked the ear.

After a boil in the ear, the ear should be most carefully syringed, in order to clean away all remnants of blood and matter which might offer a soil for this fungus. The microscope alone is able to decide whether this minute vegetable is in the ear or not. Sooner or later the fungus attacks the drum-head and inflames it, as will be shown further on.

Usually *all* earache is attended with diminution of hearing. The only exception is neuralgic pain, arising from defective teeth.

Neuralgia in the Auditory Canal. — A word must be given about a very painful disease, viz., neuralgia in the canal. This, of course, is classed with earache, and often falls under the domestic treatment for such complaints. Its cause is almost invariably decayed or improperly-filled teeth. A singular feature of this disease is, that very often the tooth which causes the pain in the ear is not painful itself, nor even tender to the touch. Of course, where toothache exists, and seems to dart into the ear, the patient is often

led, very properly, to consider the tooth as the real cause of the earache. There is no discharge in these cases, at least not at first, and there is no attendant deafness nor noises in the ear and head. When, therefore, a severe pain sets in, in the ear, without *any other* symptom in the ear, the patient should conclude that his ear is neuralgic by reflection, as it may be termed, from the decayed or otherwise diseased tooth. An examination of the mouth, in such cases, will generally reveal at least a hollow tooth, or a tender one on the same side as the aching ear.

Too frequently, however, the neuralgia is mistaken for inflammation in the ear, and improper remedies of all kinds, hot oils, fats, various kinds of vegetable matters, etc., are put in. These irritate the ear, and finally, in addition to the neuralgia, there is an inflammation with discharge from the ear. The only cure for neuralgia in the auditory canal or in the ear is the treatment or extraction of the offending tooth.

In this instance the pain will disappear on the cure or removal of the diseased teeth.

Hardness of hearing is caused by the closure of the auditory canal by bony tumors, which in many cases, though not entirely blocking the calibre of the passage, lead to the retention of wax and dead skin; on this account deafness is sometimes suddenly induced without any previous warning to the patient. Great care should be exercised in such cases not to

wound the skin, which is very tender, over these bony growths in the canal.

Sometimes cancer affects the external auditory canal; but this is a rare occurrence, and will usually be detected by the surgeon to whom the attendant pain drives the patient.

What then is the general reader to derive from having read the foregoing pages on the auricle and auditory canal — their anatomy, physiology, and diseases? Simply this, that they are highly organized and in many ways delicate structures; and that in most cases of disease, *nothing* had better be done than to resort to unskilful treatment from ignorant hands. When reference is made to the management of the ear in health, it will be shown how far this organ should be let alone, and that rational protection of the ear and the prevention of disease are very largely entirely within our own control.

The Drum-Head, or the Membrana Tympani.

Injuries and Diseases.—The drum-head, as might be supposed from its thinness and comparatively exposed position, is liable to injuries, producing in it perforation, rupture, and inflammation. A perforation or rupture in this delicate membrane is not as *directly* injurious either to hearing or to health as is generally supposed. In some respects a simple perforation in the drum-head is of no consequence, as it

will heal rapidly in a healthy membrane. Indeed, some forms of deafness are cured by a perforation in the drum-head.

The first great danger in all cases of accidental perforation in the drum-head is, that a force productive of such a fissure in it may, by concussion, affect the deeper nerve-structure of the ear. The next evil that may directly attend a perforation in the drum-head is the exposure of the delicate mucous membrane of the drum-cavity, which necessarily follows such an opening in this membrane, which forms the outer wall of the drum-cavity.

The most common forces which produce this injury in the drum-head are concussions in the form of unexpected explosions, and "boxes on the ear."

The explosive force comes on the drum-head either so suddenly that the membrane is not prepared for it, or it is so powerful and the membrane so delicate, perhaps already weakened by disease, that the membrane is unable to resist it. If the Eustachian tube is temporarily closed, the drum-membrane would be all the more likely to be burst.

These accidents are common among soldiery, spectators at military reviews, and sportsmen, and they have occurred by the sudden explosion of gas-bags used in chemical experiments.* In order to provide

* Drs. Green and Shaw, of Boston, observed five cases of ruptured drum produced by an exploding gas-bag in a lecture.

against such accidents, the soldier, during heavy cannonading, opens his mouth so as to allow of an equal tension of air on each side of his drum-head through the Eustachian tube.

This also permits all the more easily, in case of a sudden concussion conveyed through the external auditory canal, of a recoil of the air in the drum-cavity through the Eustachian tube, and the drum-head is thus relieved of some of the force of the blow.

Wearing cotton in the ear at such times has also been supposed to protect the drum-head from some of the force of concussion.

The sudden explosion of gas-bags, or of many other accidental explosions, can hardly be guarded against so far as the ear is concerned. In the event of such an explosion, if the ear seems benumbed, it should be examined immediately by an expert.

A word of caution here both to physician and patient. In all such cases of either supposed or ascertained accidental rupture of the membrane, *nothing should be put into the ear.* The rupture in the drum connects the outer ear with the drum-cavity, and any "drops" now put into the auditory canal will pass directly into the drum-cavity, and there *set up inflammation.* In all such cases, simply protect the mouth of the canal with a little dry cotton, and it will be found that in the vast majority of cases, perhaps in all, the ruptured drum-head will heal, and if the nerve

of hearing has not been injured by the concussion which has produced the perforation in the membrane, the hearing will not have been injured. It is altogether different when the rupture of the drum-head has been produced by disease, and when a running from the ear continues. The drops will then do the more good the further into the ear they penetrate.

Another force productive of rupture of the drum-head, quite common among brutal people, is a "box on the ear." This is inflicted not only upon children, but the writer observed an instance of such an injury to the drum in a man, produced by a blow over the ear, given in rude play. The *treatment* of such cases is the same as in the above. These instances of injury from a blow by the hand often come into court, and the plaintiff is usually regarded in too much the light of a greatly injured person, simply because the "drum is perforated."

Now, as has been said, if the nerve is not paralyzed by the force of the blow, the perforation of the drum-head, considered alone, is of minor importance. It has exposed the drum-cavity; but if, after such an injury, the ear has not been meddled with by the ignorant, and if nothing has been put into the ear, and thus into the drum-cavity, the membrane will heal again, and therefore the affair really demands less judicial consideration than it sometimes gets. In all such cases the condition of the ear before the blow,

as well as its condition after the injury, should be inquired into, and it should also be found out whether anything was put into the ear after the perforation of the drum-head to heal it. If the latter has been done, it may be the real cause of the subsequent pain and deafness.

There is another class of injuries to the drum, produced by the accidental entrance of a long and sharp instrument into the canal. Thus, while scratching one's ear with a pin, thin pen-holder, pencil, ear-pick, or any other similar object, the elbow may be jogged in various ways, and the pointed instrument, being so very near the drum-head, the latter is quickly perforated. This, as a rule, causes a sharp dart of pain. In one instance, the writer knew of the fissuring of a drum-head caused by the sudden entrance of the delicate end of the rib of a lady's parasol into her ear as she turned quickly in a crowded street-car. It healed quickly, but with some permanent defect in her hearing.

Great care should be exerted to avoid all risks of perforating the drum, and one way to accomplish this will be to most sedulously avoid a habit, entirely too common, of scratching the ear with pins, hair-pins, and ear-picks, or, in fact, with anything but the finger-end.

Allusion will be made to the injurious results of swabbing the ear with sponges, etc., for purposes of, as it is erroneously named, cleaning the organ. But

irritates by packing back upon the drum-head masses of wax and dead skin. The evil results of this swabbing and the removal of the natural ear-wax will be considered under the hygiene of the ear.

The growth of the fungus Aspergillus on the drum-head and the wall of the auditory canal is by no means uncommon. The cause of it is by no means neglect of the ear; it is usually one of the results of too much swabbing and picking the ear. This causes irritation of and discharge from the skin of the canal, and the fungus is thus invited to grow in the ear as the small quantities of discharge putrefy. The fungus by instinct seeks a secluded spot for growing, and is thus led to grow first and chiefly on the drum-head, which, as the reader now knows, forms the bottom of the auditory canal.

The attack thus made by the fungus on the delicate skin of the drum-head soon inflames the latter. Unfortunately, the worst thing which the patient can do is now usually done, for oil is poured into the ear. This feeds the fungus; in fact, many cases of the growth of this fungus are directly traceable to the use of oil for some previous ear-disease. The oil having been allowed to remain in the ear until it has become rancid, the fungus, of course, seeks the ear as a favorable place for growing. (*Bezold.*)

One of the best forms of treatment for an ear infested by the fungus Aspergillus is syringing with

tepid or warm water. This not only allays pain, but it destroys and removes the parasite.

Swabbing the ear and the resulting packing in of wax and skin has also been alluded to as a cause of disease in the canal and of the drum-head. The latter is often thus scraped, excoriated, and inflamed. The writer has known both men and women to scrape off pieces of their drum-heads by the use of pins, hair-pins, and other improper means of so-called toilet. The final result of all this is, a chronic ulcer on the drum-head and on the wall of the canal nearest the membrane. The ulceration is attended with the growth of granulations and little polypi, or "proud flesh," as it is more commonly called, and a foul discharge.

This ulceration usually extends to the bone, especially if the picking and scratching are kept up by the patient; and decay of the bone, a most obstinate form of disease, is established. The disease once engrafted on the ear, the patient can do nothing himself, alone and unaided, for his cure.

It would be worse than useless to attempt to lay down here a course of treatment for such a patient to follow, because polypi, or the exuberant granulations attending an ulcer as described, must be removed by surgical skill, and *only by it.*

The best advice that can be given here, is one that looks towards prevention rather than treatment. It

is from a knowledge of the vast amount of damage done to the ear by people themselves, that I can only repeat that caution so often given throughout these pages—do not pick and swab the ears. If you do, you will soon set up a disease which may be termed purely *artificial.* An erroneous management of the ear, often begun for some *imaginary* evil, will surely lead to positive and most obstinate disease of the organ.

CHAPTER II.

DISEASES AND INJURIES OF THE MIDDLE EAR.

PAIN has been often alluded to already, in the consideration given to the various diseases of the external ear. But as the middle ear, especially the drum-cavity, is the part of the ear most frequently attacked by inflammation, the cause of earache may be said to lie usually in that cavity. Excepting boils in the ear, no pain is equal in severity to the excruciating earache produced by an inflammation in the cavity of the drum. It is here that most earaches in children arise. The severity of these cases is so great that, unless relief be obtained, a child will be thrown into spasms, or pass into stupor and unconsciousness. In some cases the brain becomes so much affected by the disease of the drum that the child dies.

More usually, however, the mucus and pus arising from the inflammation distend the drum-head until it bursts, and there ensues relief from pain, but an impairment of hearing. The latter is not necessarily permanent.

The causes of this disease of the ear in childhood

are chiefly scarlet-fever and measles. Teething, whooping-cough, and severe colds in the head or chest, also furnish a certain number of cases of earache, *i. e.* inflammation in the drum. Inflammations of the drum in adults are produced by exposure to cold, and the consequent "catching cold." It may also attend pneumonia, and other lung-diseases in the adult. As has already been noted (p. 72), inflammation of the drum-cavity may arise from cold-water bathing, especially if the cold water is allowed to enter the ear or nostrils.

When the middle ear, or, more especially, that part of it called the drum-cavity, becomes inflamed, even talking, coughing, sneezing or eructation cause pain in the ear. There is more or less buzzing and singing in the ear, the patient's voice seems altered to himself; there may also be a kind of echo in the ear, and the hearing begins to grow dull. Sometimes all of these symptoms precede the pain in the ear.

After exposure to cold, an itching may be felt, running from the throat to the ear. This sensation gradually increases, passing, however, from an itching into a darting pain, which localizes itself in the ear. In other cases, however, the pain starts off at a bound, directly in the ear, and the agony in the adult, as we are informed, is intense. It must be left to the imagination, what infants and young children may suffer with inflammation of their drum.

Very often the pain is cut short, both in adults and children, by the spontaneous rupture of the drum and the discharge of matter. As this disease with this result, viz., discharge from the ear, occurs most commonly in early childhood, and forms a numerous class of patients, it demands more than a passing word, especially as with the earache and discharge begins a train of possible evils, not dreamt of by patients, and very imperfectly understood by the mass of practitioners of medicine.

So far as my experience goes, and that, too, of my colleagues in otology, this form of ear-disease is usually neglected by the general practitioner, and hence it becomes chronic, *i. e.* it persists and becomes worse. A *child will not outgrow a running from the ear* any more than he would outgrow a broken bone. It is admitted that sometimes a child has an earache, followed by a discharge, which, after a few weeks or even months, seems to undergo a spontaneous cure. But these cases are rare; while chronic cases, which have lasted any length of time from infancy to middle life, are extremely numerous. Another favorite subterfuge of mismanagement is to say that if the discharge be cured or "dried up," the patient will be injured thereby. To this it can be said that, if a discharge is *not* checked, hearing, health, and life are in danger. No one hesitates to have a sore and running eye healed, for, if it be not healed, the eye

will literally run out. The same should be the care for a running ear, for not only is the odor from a discharging ear extremely offensive, but the ear, too, like the eye, if neglected, can and does run out, and hearing goes. A neglected, running ear has this additional evil about it, that in time the inflammation works inward to the brain, and death ensues. This latter occurrence is not uncommon in chronic ear-diseases, with a constant running from the ear.

The natural question arising now is, "What shall be done to cure earache arising from inflammation in the drum?" While attempting to answer this question, it will be well to tell the patient or his friends what *not* to do, as well as what may be done.

In the early stages of earache from closed Eustachian tube and congested drum-cavity, a vigorous blow of the nose — the air being held in as much as possible, so as to force it backward into the throat — may give relief by opening the Eustachian tube. If this is not successful, as it may not be in young children, and if it cannot be done at all, as in the case of infants, air may be blown into a nostril of the sufferer in the following way: Take a short, clean tube of any kind, rubber preferred, about a foot long and with narrow diameter, and place one end of it in the nostril, on the side of the affected ear, and gently but firmly stop the opposite nostril with the finger. Then let the surgeon or the parent, or whoever

is performing this operation, blow, from his mouth, into the outer end of the tube. The child will usually cry, but this act on its part only aids in opening the Eustachian tube. One blast from the mouth of the operator through this tube, will usually suffice to inflate the Eustachian tube. This, sometimes, is all the treatment required to cure an earache. Of course there are other surgical means, but they are not to be mentioned here, as our purpose is only to give those procedures in treatment which could be carried out by an experienced nurse or non-professional person, in the absence of a surgeon. However, the pain may not be entirely due to the closure of the tube, but to absolute inflammation in the drum-cavity. The treatment just proposed would, of course, now fail to give all the relief desired, though it would in most any case, in the earlier stages, give some relief to the pain; but the latter would soon return, especially towards night, with greater severity, if the cavity of the drum be inflamed. Most relief will be obtained by syringing the ear gently with very warm water, or very warm water may be poured into the ear from a spoon. Sometimes breathing into the ear with the mouth wide open, and close to the ear of the sufferer, will give relief to earache. In addition to these methods, warm water and laudanum, equal parts of each, may be dropped into the ear and allowed to rest there a

few minutes. Cloths wrung out of very warm water may be placed around the painful ear, *but never over it.* If laid over it, such dressings tend to produce "proud flesh" in the ear.

But beyond these modes of domestic treatment for earache no one should go, without consulting some one who understands the structure of the ear and the treatment of its diseases.

This may seem very odd to those who have been used to dropping all kinds of oils, and worse than useless materials, almost too numerous to name, into the ear when it aches, and who then let it alone when it begins to run and smell, and really demands treatment. These it may be well to tell what *not* to do. It would, indeed, be vastly better, in many cases, if the ear were let alone *before* it begins to discharge matter, instead of after it has begun to run.

Lancing the Drum.— To those suffering with earache from pent-up matter in the drum, the knife brings the quickest relief. When the matter has formed behind the drum-head, and the latter has not spontaneously burst, it must be perforated. The delicate needle-like knife of the surgeon must now be run into the distended drum, not only because it gives relief to pain and the deafness, but because the surgeon can usually choose a better point for the discharge than nature, and he can make a smaller and safer opening in the drum. It is then often

the choice between a prompt relief from a small temporary opening, or long continued agony, and finally a breaking down and total destruction of the drum-head, with the attendant probability of great loss of hearing at last. The surgeon is right, therefore, when he proposes to lance your drum, if it is painful and distended with matter. Do not fear; his cut will soon heal, and your drum will be safe. This short exhortation seems demanded on account of the widespread, though entirely unjust, prejudice against perforating the inflamed drum-head.

What not to do.— When speaking of diseases of the external ear, caution was given against putting in a number of substances very generally and very erroneously resorted to. (See p. 74.)

Among the articles there mentioned was sweet oil; and it must be said here that this is one of the articles not to be dropped into the ear for earache.* For it will not cure the pain, to begin with, and it is greasy, and hence, for the treatment of the ear, dirty. It is heavy, sticky, and cloggy. Hence, in cases of tenderness of the drum, the pain is rather increased, than otherwise, by putting oil into the ear. If the surgeon is finally required to examine the ear after oil has been dropped into it, he will be unable to see the drum-head plainly, on account of this obstruction. Hence the oil must be removed, which is not easily done without soap, water, and a syringe.

* The exception to this rule is given on page 62.

This latter manipulation may give pain, when it might not have occurred, had oil not been put in the ear. If, however, the pain abates, and the surgeon is not called in, the oil is forgotten, and allowed to remain in the ear. Here it soon becomes rancid, and hence a fit soil for the growth of the fungus Aspergillus. The latter, as soon as it begins to grow, excites in the ear a painful and serious inflammation. (See p. 73.)

What has just been said about sweet oil, may be with equal force urged against the use of any other fat or oil in the ear. They do no good to the pain, and in the end they may breed disease in the ear. All the seeming and vaunted benefit connected with the use of fats and oils about the ear, is due simply to the heat communicated by them to the painful ear, since they are usually heated before they are dropped into the inflamed organ.

There is also a number of other injurious matters which are often, but should *not* be, put into the ear when it is inflammed and aching.

Prominent among these is the core of a roasted onion. Here the heat of the roasted vegetable generally gives relief; but all of the onion put into the ear is scarcely ever entirely removed. Large pieces are sometimes forgotten, or they defy the efforts of the patient at removal, so that they remain in the ear until they putrefy. Then the intolerable odor as

well as the discomfort arising from the remains of the onion, usually call the attention of the patient and his friends to the ear, and the surgeon's aid has to be asked for.

In some instances, the subsequent inflammation, excited by the use of this favorite domestic treatment, is so extensive as to excite ulceration of the auditory canal and of the drum-head, and in some cases proud flesh springs up.

Not only the onion, but various other vegetable matters, as mashed carrots, potatoes, and the like, are applied to and put into the ear. The same results, as just ascribed to the use of onion, may also arise from the use of any vegetable matter put into or poulticed over the ear for relief of pain.

All of these matters are forms of poultice, and every one should learn that a poultice over either the ear or the eye, will act injuriously on the organ. If a poultice of any kind be placed over an inflamed ear for a short time, even for a few hours, irreparable injury may be done to the organ. This will be manifested by a mass of granulations (proud flesh) springing up in the canal, the breaking down of the drum-head, and the falling out of the little bones of the ear. It is needless to say that this destroys forever the hearing. Not only may the hearing be destroyed by such mismanagement of the ear, but a

chronic running from the ear may be thus established.

Chronic Deafness with a Discharge from the Ear. — When such a chronic discharge from the ear has become fully fixed on the ear, the usual course on the part of badly taught patients is to desist from all treatment. And this is hardly to be wondered at, for their experience with domestic treatment has not been satisfactory. But now is the time that something should be done to rectify mistakes in treatment, and to try to check the discharge. This is not always easy to do, especially if the drum-head is largely perforated, as it is apt to be, or if a polypus has sprung up in the ear. Treatment for a discharge may be continued indefinitely, without avail, if a polypus be in the ear. It must be removed from the ear before the discharge will cease, and then a discharge is usually easily checked. In many cases the discharge seems first to excite the growth of the polypus, and then the latter seems to keep up the running from the ear by the irritation it sets up. A polypus may be attached to the walls of the canal, the drum-head, or to the walls of the drum-cavity — usually the latter. It looks, certainly in its earliest stages, and even for a long time, like a miniature cherry fastened to its stem.

After this chronic running has kept up for a time, and after a polypus has grown, or whether it has or not, the bone may become diseased, the hearing

gradually fail, and, as already said, the brain may become diseased, and death ensues. All these statements should not unduly alarm the reader, but only induce him not to neglect his ear or his child's ear, nor yet to do the wrong thing for it when inflamed. It may very justly be said that inflammatory diseases of the ear, like inflammatory diseases elsewhere, are amenable to proper treatment, and also that there are men in every community fully able to treat them, and to these an ear-disease should be entrusted as soon as possible. Science of the present day has placed in the hands of the educated surgeon special means for the relief of ear-diseases, which he alone can apply. It would therefore be very plainly out of place to mention them here, where it is supposed a brief outline of hygiene, rather than treatment of disease, is laid before the non-professional reader.

There is one direction that should be given here for the management of an ear affected with a chronic discharge. It is to keep it perfectly clean by means of syringing once or twice daily, or oftener, if necessary. This will tend to keep down the disease, and place the ear in a better condition for proper treatment when a surgeon can be called on for aid. How to syringe the ear has been described on pages 62 and 63.

All oils are of no avail in checking a running from the ear. They only serve to block up the auditory

canal and increase the liability of putrefaction of retained matter, which will in turn bring about at least a disagreeable odor. When this latter condition is once fully established, the ear may attract flies, which will enter the ear, deposit eggs, and in a short time thereafter maggots will attack the more delicate parts of the canal of the ear and the drum-head, producing the most intense agony.

The constant presence of this offensive matter in and about the ear certainly tends to poisoning the blood of the patient, and not uncommonly death is the direct result of this form of ear-disease.

A discharge from the ear, as described above, cannot exist without a perforation in the drum-head. After the discharge ceases this perforation may heal, but in many long-continued cases it does not. In such cases, after the discharge has ceased, the hearing may be improved by wearing what is known as a false or artificial drum. The best are the simplest, consisting of cotton pellets, to be adjusted by the surgeon at first, and possibly thereafter by the patient. There are numerous other forms, consisting of rubber discs and wire handles, which are not only useless in most cases, but often produce positive injuries by the irritation which they create in the ear.

Chronic Deafness without Discharge from the Ear. —Very often earache is not attended by a discharge. This is equal to saying there has been no rupture of

the drum, though matter may have formed behind it. In these cases the inflammation goes down, either of its own accord or because the treatment has allayed it. The matter, therefore, which may have formed is small in quantity, and has either escaped into the throat by the Eustachian tube, or still remains in, though not filling, the cavity of the drum. In these cases the ear continues to feel stuffed up, and is liable to feel every change in the weather, or every cold the patient may catch. Such cases are the foundation of chronic hardness of hearing, and are usually found in connection with chronic catarrhal disease of the throat and nose. There is more or less buzzing or singing, either steady or with the pulse, in both ears or in one only, and sometimes a dizziness in the head,— all of which greatly distress the patient, and frequently depress his spirits. With this form of ear-disease, ear-dizziness may be a prominent attendant. This kind of dizziness will be more fully spoken of under Aural Vertigo.

Gradually, too, the hearing fails in one or both ears; the patient begins to lose some words, first at church or in lectures; then conversation begins to be attended with some difficulty; a sense of confusion in the head comes on when in the midst of great noises, as in the street, or when in a large room filled with a number of talking people.

This kind of ear-disease, chronic catarrh of the

ear, is the most common cause of hardness of hearing and deafness, and as such is the object of many forms of treatment and much quackery. It may be said at the outset that nothing can be put into the external ear which can in any way benefit this form of deafness. As a rule, any kind of drops put into an ear affected with chronic catarrh will do more harm than good.

The disease lies beyond the drum-head, in the drum-cavity and in the Eustachian tube. Now, as the drum-head shuts off, air-tight, the middle ear from the external ear, drops put into the latter can by no means reach the former. They only fall on the drum-head and irritate it.

Treatment to be of avail must be directed to the throat, the nostrils, and the Eustachian tube; possibly through the latter to the drum-cavity. But that is a matter to be left to the judgment of the surgeon.

The body must be properly, that is, warmly, protected with heavy under-clothing, a matter not to be specially described here, and the feet must be most carefully kept *warm and dry*. The condition of the feet has a most intimate relation with the welfare of the throat and the ears. See Primers on "Throat" and "Winter and its Dangers."

If, on going into the open air, the ear or ears should feel the cold until they ache, then they must be protected either by ear-muffs, a veil, a scarf, or a piece of cotton in the mouth of the canal of the ear.

Of course, mere coldness of the auricle in very cold weather is to be expected, and is not specially prejudicial to hearing. What is alluded to here is earache, deep in the ear and throat under the ear and jaw, and hence the words of caution as to protection. But in no case must cotton be worn in a running ear.

Catarrh Explained. — The word catarrh is used here in reference to diseases of the ear, and will be thus used in future. It will therefore be necessary to say that catarrh as used here does not refer to the offensive disease of the nose and head, to which this word is so constantly applied, especially in newspapers. The disease in that case ought to be called "fetid catarrh of the nose." Catarrh really means a "running," and hence it is applied to inflammation of the mucous membranes generally. As this membrane is the chief seat of disease in ear-disease and deafness, these complaints have justly been termed "catarrh." But there is a wide difference between *fetid* catarrh of the head and chronic catarrh of the ear. In fact, they are rarely found together in the same individual.

This explanation of the difference in these diseases is demanded, because patients are often misled and imposed upon by not knowing that catarrh does not necessarily mean a disease of the head, with an offensive odor. This want of proper knowledge on their part, and avarice on the part of unscrupulous quacks,

often lead the suffering into doing the wrong thing for their chronic ear-catarrh and deafness. Hence it may be well to state what should *not* be done in such cases.

It may be said with absolute certainty that all so-called catarrh-snuffs, sold with loud advertisements and bright coverings, are injurious to the nose and ears. The same may be said of all so-called catarrh remedies in fluid form which are given to be *snuffed* into the nose.

In fact, nothing should be forcibly snuffed into the nostrils, not even cold water. Man is a warm-blooded land animal, and therefore not made to endure taking cold water into his breathing passages nor into his external ear. All mammals (*i. e.* animals of the class to which man belongs), such as seals, beavers, etc., when obliged by their habits to go under the water, hold their breath. What is still more in favor of the safety of their ears, they possess either the ability to voluntarily close the external ear, or it is so small and crumpled about the mouth of the auditory passage as to keep water out. This can be seen in seals and otters. In this connection it may be stated that hunting-dogs, trained to dive, usually grow deaf after a few years of such service, since they are not provided by nature with the means of protecting their ear-drums. In many cases of chronic catarrhal deafness, combined with chronic catarrh

of the throat and nose, fluid applications, as recommended by the surgeon, are of value. But these should *never be applied cold.* Their coldness, of itself, is very likely to produce catarrhal disease rather than cure it.

There is an instrument called the *nasal douche*, much used and much abused. It consists of a vessel to hold a fluid, and a tube to convey the latter to the nostrils. By allowing a fluid to enter one nostril, the mouth being open, the current of fluid thus conveyed to the nose flows through one nostril into that part of the throat, above the palate, called the nasal pharynx, bathing that region, and out by the other nostril. This physiological fact, often employed by the regular surgeon with advantage, is not only known to, but also utilized by, the quack, and instruments for performing this operation are largely sold, under various names, in some parts of our country. Most of these instruments are imperfect, are unaccompanied by proper directions for using them, and are sold by persons unable to give proper instructions to patients who buy and employ them without the advice of a physician.

When properly constructed and applied, the nasal douche is of great value and perfectly safe; but when improperly made and unskilfully used, it leads to direful results to hearing. The best douche consists of a glass bottle, to the side of which, close to the

bottom, an opening is made for the attachment of a rubber hose, about 2½-3 feet long, to the free end of which an olive-shaped glass nose-piece is fastened. Of course, its popular use is for nasal catarrh, or "catarrh in the head," as some people call it. But the writer constantly meets with serious diseases of the ear, produced by the improper use of the nasal douche.

The chief mistake in these cases has been that the fluid injected into the nose has been *cold*, and also the vessel holding the fluid has been held *too high*. As has been said, the fluid thus used, or in any way dropped, poured, or put into the nose, must be warm. The vessel containing the fluid to be applied to the nostrils must be so held that the surface of the fluid in it shall not be above the eyes of the patient. If held higher than this, the fluid may enter one or both of the ears of the patient through the Eustachian tube. Now if this happens, whether the fluid be hot or cold, the ear will most probably be inflamed by it. A sense of fulness is felt, with pain sooner or later in the ear, and perhaps also in the brow, the top of the head, or even in the back of the head.

The fluid thus employed should rarely if ever be anything more than warm water, to which, perhaps, a little salt may be added, in the proportion of a teaspoonful of the latter to a pint of water. After using the douche, the patient should remain in his room for fifteen minutes, and this room should never be a cold one. But the safest plan to pursue is never

to use a nasal douche unless directly ordered by a competent surgeon, and he will *not* tell the patient to tie the bottle to the chandelier and then let the water run through the nose. The physician who thus advised his patient (and such an instance came under the writer's observation) was not competent to prescribe the nasal douche.

Catarrh Snuffs.—So far as these are concerned, it can be said that both the dry powders and fluid forms for snuffing into the nostrils constantly produce ear-diseases. Not long since, the writer was consulted by a gentleman who, for a slight catarrh of the nose, had bought and used one of the numerous advertised remedies for this disease. One powerful snuffing of the fluid drew it directly into the Eustachian tube, and set up a sudden and painful inflammation in the drum.

As these so-called remedies do no good to the disease in the nose, and as they may do harm to the ears, the writer feels that he must proclaim his disapproval of them, on the ground of their positive harmfulness.

Diseases of the Eustachian Tube.— The diseases of the Eustachian tube amount to diseases of the ear. A cold in the head or a sore throat may, at any time, affect the Eustachian tube, as they are lined with the same mucous membrane, and are of course very close together. It is the simultaneous affection of the Eu-

stachian tube in an ordinary cold in the head, that gives the stuffed feeling and alteration of sounds in the ear. This stuffed feeling should not be neglected, if it does not pass off in a few days. Should it continue, it will show that more than ordinary swelling has occurred in the tube, and it will be found that the hearing is slightly impaired.

Usually, as the cold passes off, this peculiar feeling in the ear or ears passes away. If this does not take place, and the tube is allowed to remain closed up, with the consequent stopped feeling in the ear, the tube falls into a chronic condition of inactivity and an inability to open itself at every act of swallowing. If this closure is allowed to continue, the drum-head falls in, and a vacuum forming in the drum-cavity, the bones cannot swing to and fro, and deafness begins to come on. The entire hearing apparatus then falls out of use, and a proper exercise of its function. Like every other part of the body, if the ear is kept out of proper exercise, it loses the ability to act; and if now the tube is opened, and air is allowed to enter once more the drum-cavity, it will be found that the hearing is greatly reduced.

This is supposed to be due to the stiffening of the bones of the ear. From what has been said of their function as sound-conductors, it is evident, that if they are stiffened or impeded in any way in their vibratility, the hearing must become impaired. This

would not necessarily be the case had the Eustachian tube been promptly opened. The latter can be done most efficiently by the inflation-bag of the surgeon. In children this tube is often closed up, and kept closed because their nostrils are stopped up with mucus. The child then begins to breathe through its mouth, which causes a further obstruction of the nostrils by a collapse, so to speak, of their outer and soft walls. The mucus is thus allowed to harden and to become firmly fixed in the breathing passages, the mouth and throat become dry and diseased from constantly breathing directly through the mouth, and thus irritation is kept up and passes further into the ear from the throat behind the palate.

The stoppage of the Eustachian tube from all these causes, especially in little children, is one of the most fruitful sources of earache and deafness. As will be further shown under the hygiene of the ear, breathing through the nostrils is necessary to hearing and good health, while breathing through the mouth is not only disfiguring to the countenance, but very injurious to the hearing and the throat, and finally may bring on lung-diseases.

Tonsils and Palate.— With diseases of the Eustachian tube, the nose, and the middle ear, there is often found enlargement of the tonsils and the palate. We then often hear the expression that the "palate is down," by which is meant that the little

grape-like appendage in the middle of the edge of the palate is elongated by disease. This may be either a temporary swelling or a permanent enlargement.

Without entering into a discussion of diseases of the tonsils or the palate, it is necessary to state that enlarged tonsils have very little, if any, part in the production of deafness. They are usually enlarged from the effects of the same disease of the mucous membrane, or of the system in general, which has also caused disease in the ear. Cutting out the tonsils is not going to cure the deafness. If these organs of the throat become too large, they can be made smaller by caustics much more advantageously and painlessly than by means of the knife.

When the uvula of the palate becomes longer than natural, and the palate is then said to be "down," an irritation is set up in the throat, and the patient not only has a tickling cough, with a sensation as though something were sticking in his throat which he cannot remove, but an irritation in the throat, caused by the constant rubbing of the elongated palate against the walls of the throat, is kept up and transmitted to the upper part of the throat behind the nostrils and to the Eustachian tube. When the latter becomes diseased, as we already know, the ears are in danger, and the hearing may become greatly affected.

Clipping off the superfluous tip of the uvula — as much as the $\frac{1}{16}$ or $\frac{1}{4}$ of an inch — will do away with this mechanical irritation in the throat. As, what is to be cut off, is only the surplus of mucous membrane, and not muscle, only good can arise from the operation. But, unfortunately for this operation and for numerous patients, they have allowed their entire uvula to be cut off, and the result has been not only a painful sore-throat, but the palate has been deprived of an important appendage which should never be entirely removed. When, then, this appendage is too long, only enough is to be removed to render the remnant of an ordinary size, and thus prevent the tickling and irritation of an unnaturally long one. All surgeons are supplied with the means of rapidly cutting off the tip of the uvula. The operation is instantaneous and painless, and when promptly done may prevent deafness.

Mastoid Disease.—When we were considering the anatomy and physiology of the middle ear, allusion was made to the mastoid bone (see p. 33) and its close connection with the tympanic or drum-cavity. This part of the middle ear may also become the seat of a most painful and dangerous inflammatory disease. This bony cavity behind the drum, felt as a prominence or lump behind the ear, is hollow, or, at least, a collection of hollow cells, and is lined, like the cavity of the drum, with mucous membrane. The

latter very easily partakes in the diseases of the drum, especially when the latter is the seat of a chronic or long-continued discharge. In such cases the bone becomes diseased and the cavity of the mastoid cells becomes choked with pus. The pain is usually intense, as the matter, being confined in a bony case, cannot escape. This cavity on its inner part is in close contact with a thin wall of bone, which separates the cavity from one of the great blood-vessels of the brain. This inner wall, being so much thinner than the outer wall behind the ear, gives away soonest to the ravages of the disease, and matter thus passes from the mastoid cavity to the brain. In fact, this disease is one of the bad results very likely to follow neglect of a running ear, or, in fact, of any kind of acute inflammation of the middle ear.

This is not, however, a very rapid disease, and, as a rule, the patient and his physician have ample warning of danger in attacks of pain. If these are not properly relieved, *i. e.* if the mastoid cavity is not properly drained, the pain becomes more severe and constant, the patient fails rapidly, at last, in strength; his blood seems to be poisoned, abscesses may form in his neck or elsewhere in the body, delirium and unconsciousness ensue, and finally he may die in convulsions. In order to prevent this final and fatal result, when the pain shows signs of becoming constant and intense, and when the pro-

tuberance behind the ear becomes tender to pressure from the finger, the patient should lose no time in consulting a surgeon, for the latter can give relief to pain and ward off danger by making a hole in the bone behind the ear, and letting out the pent-up matter. Where this operation has been performed in time, life has been saved; but where it has not been permitted, death has ensued.*

* See papers on this subject by A. H. Buck, M. D., of New York; Archives of Oph. and Otology, Vol. III., 1873; J. Orne Green, M. D., of Boston, Boston City Hospital Reports, Second series, 1877; Dr. H. N. Spencer, of St. Louis, Transactions Medical Society of Missouri, 1875.

CHAPTER III.

DISEASES AND INJURIES OF THE INTERNAL EAR, INCLUDING DEAF-DUMBNESS.

DISEASES and injuries of the internal ear are not very numerous, nor are they clearly understood. In this chapter, therefore, it shall be our purpose to consider some of those aural symptoms which usually have been called nervous phenomena, though they are not apparently as closely connected with disorders in the labyrinth of the ear as they were once thought to be. It shall also be our endeavor to allude, at least, briefly, to some diseases manifestly connected with the labyrinth.

In the closing part of the chapter, we shall also give a short account of deaf-dumbness, and the causes which may lead to this affliction. Throughout the following pages the endeavor will be constantly made to point out how the maladies alluded to may be alleviated or, if possible, prevented. The general management of deaf-mutes, especially their education, will be referred to in the last part of the book.

Noises and Ringing in the Ears and Head.—There

is no symptom, deafness alone excepted, more frequently complained of among aural patients than noises or ringing in the ears. There is no disease of the ear which may not produce this disagreeable sensation, and there are other diseases, not purely aural, which sometimes provoke this sensation in the ear. It is, of course, a morbid or perverted sensibility of the nerve of hearing. I do not mean that the nerve is always the seat of disease — it is usually not — in cases of this abnormal and disagreeable sound in the ear or ears; but the nerve of hearing is improperly excited or impressed in such cases, and the causes are numerous.

All the forms of ear-disease already mentioned, may produce ringing, hissing, etc., in the ear, and sometimes these noises seem to extend into the head. These noises are likened to sounds with which the sufferers are most familiar, excepting among the insane. The latter may imagine their aural noises to resemble anything.

It is important for the reader to know that some of these noises in the ear — subjective noises, as they are termed, because originating in the person or subject, and audible only to him — are easily curable, while others are hard, or even impossible to cure. Yet, in most cases, noises in the ear will in time cease.

It should be borne in mind, however, that noises

in the ear, accompanied by hardness of hearing, are indicative of aural disease; but that those sounds in the ear, unattended with alteration of hearing, are due to some derangement of the system, most probably in the stomach or in the nervous system. Noises in the ear always demand attention, especially if they become persistent. An ordinary passing ringing or cracking sound in the ear, calls for no attention.

It will be in place here to say that in some very rare cases,—there are only about a dozen on record,—the muscular structures in the ear and in the Eustachian tube undergo spasmodic twitchings, which produce a snapping sound, not only audible to the patient, but also to those near him. The writer once observed such a case, in which the snapping sounds were audible to him ten or twelve feet away from the patient.

All subjective sounds can be treated only by the physician. It may be said that any attempts to cure these noises by putting drops in the ear, will, in all cases, increase the noises. If the noise is due to the presence of a foreign body in the external ear, the removal of the offending matter will quell the noises, as ringing, singing, etc., which may have been perceived in the ear.

The most obstinate noises in the ear, however, are those produced by a disordered circulation of blood in the ear. This is especially the case in catarrhal

diseases of the drum-cavity, (p. 78.) Ringing in the ear is also an accompaniment of some diseases of the internal ear, *i. e.* of the labyrinth. This form of ringing in the ear is very likely to be attended with vertigo or dizziness.

Dizziness in Ear-Disease.—Dizziness, accompanied sometimes with reeling, nausea, and vomiting, may be an attendant of various forms of ear-disease. In rare cases, in addition to these symptoms, there may be stupor, unconsciousness, or epileptic seizures, and the patient may be thought to be in an ordinary epileptic fit. Foreign bodies in the ear have produced not only symptoms of fits, but also temporary paralysis. The removal of the foreign substance from the ear, has been followed by an instantaneous and permanent disappearance of all these peculiar phenomena. It can be said that dizziness may be produced by disease in the external, the middle, or in the internal ear, and also by disease in the nerve of hearing itself.

The general term applicable to all cases of vertigo arising from these causes, is *Aural* or *Ear Vertigo.* It remains for the careful search of the physician to determine where the true cause lies, that is, in what part of the ear, and then to assign a definite term to the malady. One of these terms, "Ménière's disease," is applicable only to a disease of the semicircular canals, an affection very rare and difficult of diagnosis.

But this term, "Ménière's disease," is constantly and very erroneously applied to all forms of *aural vertigo.*

If aural vertigo be due to disease in the middle ear, its true nature must be determined, then combated and cured. Disease of the throat-muscles, extending to the small muscles of the ear-drum, retention of matter in this cavity, and stoppage of the Eustachian tube, and a consequent vacuum in the drum, will produce giddiness.

This is due to the pressure conveyed to the water in the labyrinth, and thence to the natural fluids in and around the brain, and to the brain itself.

If this abnormal pressure in the labyrinth is kept up long, it will end in chronic disease of the ends of the nerves in the various divisions of the internal ear, and constant tendency to attacks of ear-vertigo.

Tumors of the brain, near the auditory nerve, and tumors in the nerve itself, produce not only a variety of general symptoms, but also marked symptoms in the ear, as ringing, and absolute deafness with vertigo and staggering. The tumor may continue for years without a fatal issue.

Treatment of Aural Vertigo.— Both physician and patient should be careful not to ascribe to "biliousness" the symptoms arising in aural vertigo. Yet this mistake is constantly made, and consequently the wrong treatment followed. It may be said that a treatment beneficial in an attack of so-called "bil-

iousness," which in some respects an attack of aural vertigo closely resembles, is absolutely injurious in the latter disease.

If aural vertigo be due to a foreign body in the external ear, removal of the offending object will cure the vertiginous and any other symptoms excited by the irritation in the outer ear, as already stated.

When due to disease in the middle ear, as described on page 106, these symptoms can be successfully treated. The throat disease should be cured, and if there be foreign matter in the drum, it should be removed. When a vacuum exists in the drum-cavity, opening the Eustachian tube will ventilate the cavity of the tympanum and do away with the vacuum. Diseases of the labyrinth are not so easily overcome, and hence the vertigo arising from them is more obstinate than in the previously-named diseases. The symptoms arising in the ear, in cases of tumor of the brain and auditory nerve, or in either one alone, are incurable.

But it should be stated here, that as a preventive of aural vertigo of the last form, imprudent exposure after *excessive* heating should be most carefully avoided. It is a most significant fact, that numerous cases of tumor of the auditory nerve have been directly traceable to cooling off the exhausted body after great exposure to heat and the consequent perspiration.

This direful result has followed upon a careless falling asleep with the head on the window-sill on a summer night, after the body had been fatigued and heated by the exhausting temperature of the day, as in the case of a woman related by Dr. Boettcher, of Germany. A post-mortem examination revealed a tumor in the brain. One of the most marked cases of aural vertigo from disease in the internal ear which the writer has observed, occurred in a gentleman who retired with only a sheet for covering after being exhausted and heated by an oppressive day in June. He lay in a draught and exposed to the cooling air of the mountains, where he happened to be at that time. As every one should know, the radiation of heat after a hot day is very great in mountainous districts. This had such a bad effect on the body of the patient alluded to as to render him stiff and sore. In a few hours after this exposure, aural symptoms — ringing, deafness, dizziness, nausea, and vomiting — set in. Total deafness of one ear, with tendency to dizziness, continued in this case.

Injuries to the head may be the cause of a tumor of the auditory nerve, and consequently of the worst forms of deafness and aural vertigo.

Effects of Concussion on the Internal Ear. — The effects of concussion on the ear, but especially upon the drum-head, have been alluded to on p. 67. Many

of these cases, in which the drum-head is injured by concussion, also sustain injury in deeper and more tender parts, viz., in the labyrinth and in the auditory nerve. Thus a "box on the ear," a blow on the ear or head of any kind, or a fall may be the direct cause of concussion and permanent deafness. Sometimes the deafness is total as well as sudden. These cases rarely recover hearing under any treatment, and it is doubtful whether anything could have been done to prevent the loss of hearing, had treatment been instantly applied. Where, however, the deafness is only *partial*, and the ringing in the ear keeps up for some time after the concussion, no matter what its nature may have been, treatment may do much towards restoring the hearing. But whatever is to be done must be done at once. In such cases, small doses of strychnia are probably our best means of treatment.

Deafness from concussion, as a tumble down-stairs in childhood, or from a severe blow of any kind on the head, may be the foundation of deaf-dumbness, if the injury occur before the child has learned to talk. And even after a child has learned to talk, if a total loss of hearing occur, let us say before the sixth year, the child ceases to talk. Not being able to hear, it loses the disposition as well as the incentive to talk, its vocal organs fall into disuse, and, though it may always retain the ability to utter words, it uses them

imperfectly from want of practice, and becomes, practically, a mute. In such cases, every endeavor must be made to induce a talking child to keep on talking, as will be shown in Part III.

Disease of the Semicircular Canals.—These peculiar canals and their function have been alluded to on p. 54. When, therefore, these canals are diseased, their function would necessarily be impeded, perhaps destroyed, for the time being. Many curious disturbances in equilibrium and other symptoms, as described on p. 54, have been ascribed therefore to a disease in the labyrinth, and probably in these semicircular canals. But as their functions are not positively known, their diseases are, as a matter of course, not easily made out. It would be well, however, for persons afflicted with ear-vertigo, (and some symptoms in the train will point to the ear, as at least partially affected,) to be careful not to imagine that their symptoms are those of biliousness.

It is very probable that many cases of aural vertigo are not due to disease in the labyrinth, and hence in no way connected with a disease in the semicircular canals. It may be said that aural vertigo, when due to disease in the labyrinth, *i. e.* in the internal ear, is accompanied with total deafness in the affected ear or ears. On the other hand, ear-vertigo, due to the presence of a foreign substance in the external ear or by derangements in the drum-cavity, is not attended

with total deafness. The latter kind of aural vertigo is much more easily cured than the form in which the deafness is profound; nevertheless, even the more serious form is amenable to treatment. All kinds of aural vertigo are distinguishable from epilepsy, or fits, by the fact that in the former there is no loss of consciousness, while in the latter the patient becomes unconscious.

The Deaf and Dumb.

When a child is born deaf, or becomes deaf before it has learned to talk, it is said to be deaf and dumb, or a deaf-mute. In some instances the child is deaf from a disease which has also rendered it stupid intellectually; but, as a rule, a child becomes a mute only because it has never heard the sounds of speech. In such cases, the child has no idea of what spoken language is. It was once supposed most mutes were born deaf; but this is not the case, one-half in some schools being known to have been born with the power to hear.

We have already said that a blow on the head, as from a fall, may entirely destroy the hearing while the child is a mere infant. This accident may be entirely forgotten, if it occur while the child is very young; but when it has reached the age when it ought to talk, the parents grow anxious, and then, upon being questioned, they recall the accident

which, in all probability, destroyed the hearing of their child.

But very often no such accident can be assigned as the cause of deaf-dumbness. However, it will then be found that the child had a severe attack of fever and, perhaps, convulsions in early infancy, or it may have had severe catarrh of the chest, or scarlet-fever, measles, or whooping-cough, with or without running from the ear. Any one of these may be the direct cause of deafness, and the child thus deprived of hearing cannot learn to talk.

In some deaf and dumb children a running from the ear is known to have existed all their lives, and is still active when they are brought to the physician for examination. In others, again, the drum-head bears unmistakable evidence of disease, some of which, perhaps all of which, could have been cured if promptly treated. It is in such cases we see the folly of letting ear-diseases alone "to be outgrown." The disease may indeed cease without treatment, but before it departs it destroys the child's hearing.

A child may grow deaf and dumb from an ear-disease which has never produced any running from the ear. In such cases, the Eustachian tube becomes closed, and remains so until the drum-cavity is so long deprived of air as to lose entirely its function. In such cases, after a few years of closure, the drum can never be restored to health and hearing-power.

If a child be born deaf, its defect will soon become apparent by the insensibility it shows to noises when it is asleep. The jarring of its bed by direct blows, or from concussions in the street, may arouse it by shaking it, and this is misconstrued into its hearing such sounds. The mere fact that babes are so easily aroused by noises would show that very few are ever born deaf. Again, how soon a child learns its name if it can hear. If it never learns its name, or ceases to be attracted by its mention, then doubts may indeed be entertained as to its hearing.

Deaf-dumbness may be hereditary. The writer has seen this in a family where the mother was very deaf, all the children were deaf, and some of them so deaf, and at so early an age, as to be dumb. In such cases, there may be a grave doubt as to the propriety of members of such a family marrying, and thus running the risk of propagating a mute stock. This should be one of the considerations in the intermarriage of mutes or in the intermarriage of relations, especially if among the latter there should be either a tendency to deafness or to deaf-dumbness. When deaf-dumbness is plainly due to an accident or to disease in infancy, without there being any other cases of deaf-muteness in the family, nor any sign of a tendency to catarrhal deafness, there would be no danger of transmission of the defect to posterity.

PART III.

General Hygiene of the Ear.

CHAPTER I.

THE CARE OF THE EAR IN HEALTH.

EVER mindful of the object of this book to point especially to the prevention of disease and the preservation of the faculty of hearing, this last part of the work shall be devoted to a consideration of the care of the ear in health and in disease.

As a rule, there is either too much toilet of the ears, or there is improper protection of them. On the other hand, there is most flagrant neglect of them, even in health; the organs are unduly and carelessly exposed to bad weather and cold water, and disease is thus brought on in what might have continued to be a perfectly good ear.

The Auricle.—To begin with the auricle or outside ear, it may be said that it should always get moderate and gentle washing with a wash-rag in preference to a sponge, and then a gentle and thorough drying.

Whenever it is desirable to protect the ears from cold air or a draught, it should be done by placing over them something that will sit lightly on them, and hence not bind them close to the head. A light and loosely-fitting cap is excellent for the protection of the ears as well as the bald heads of infants. But a tight cap will do their ears great harm by pressing the auricles against the head, causing not only increased perspiration, but, by thus binding down the ears to the perspiring surface, macerate the skin of the ears and set up a disease like "milk crust."

Respecting the soap to be used about the ears not only of adults but of infants, it may be said that the best are the simplest. A good soap is not easily obtained. Perhaps a *little* Castile-soap is the safest for children. There is a very good soap called the "Savon de Guimauve," a French soap, which is bland, cleansing, free from odor, and hence less liable to putrefaction. Any soap that sours easily should not be used about the ears, nor, in fact, used at all in personal toilet. Children's ears are, as a rule, not only too much washed, but very rudely and painfully washed, especially in the canal of the ear, as we shall speak of further on.

If any one suffers from cold in or about the ears, a light ear-muff or a piece of cotton wool placed lightly in the ear, or ear-pieces from the cap, or a woollen scarf around the ears, will be sufficient protection.

In the case of women, a veil or hood will amply protect the ears from cold.

The ears may be protected from the sun by a broad brim to the hat or by a light cape falling from the cap, as in the so-called "Havelock;" and this will also protect from the sting of insects. The latter covering, however, is apt to be very warm in just the countries where it is most required for protection. A broad hat and a light net or veil will, in such lands, best meet the needs of the soldier or traveller.

Piercing for Ear-rings demands a word of caution. It is usually done by jewelers, and consequently some important points may be unknown to them.

In the first place, the instrument used for piercing the lobule should be thoroughly cleansed after each operation, otherwise a small quantity of animal matter may remain on it, undergo putrefaction, and thus poison the next person operated on. Diseases, too, could thus be communicated from one individual to another. Another point to remember is, that nothing but the soft lobule should be pierced. Where this is small or hard, the greatest care is necessary to insure against perforating the cartilage, which, in all probability, extends into the lobule as stated already.

Ear-rings are sometimes torn from the lobule, thus causing a slit, which heals leaving an ugly deformity in the shape of a kind of double lobule. In one

instance, the writer saw a lobule that had been torn twice, thus leaving two permanent slits in it and giving the ear a fringed appearance. After the wound is made, properly fitting together the raw edges would prevent the deformity; but the latter once formed by healing wrong, can be corrected only by the surgeon's knife.

A word of caution must therefore be given here respecting that most reprehensible custom of pulling children's ears in punishment. Though this practice is not as dangerous to hearing as one already named when considering the drum-head, viz., "boxing the ear," it is nevertheless open to great condemnation, as being not only cruel, but very likely to inflame the dense fibrous tissues holding the auricle in place. Such an inflammation, if not speedily checked, would lead to hardness of hearing, and, perhaps, permanent deafness. Should the bone entering into the frame-work of the ear, underlying these inflamed structures, also become involved in the aforesaid inflammation, results even fatal to life may ensue. The auricle is often subjected to considerable roughness in washing. This should be avoided, as it is not necessary to cleanliness, and often excites general inflammation of the part or local inflammation in the form of boils. After washing the auricle, great care should be taken to dry it thoroughly, and also the prominent bone behind it and the hair that,

in some persons, lies very near or even touches it. If any dampness is allowed to remain in or about the auricle, evaporation, as every one ought to know, reduces the temperature and renders the ear liable to "catch cold," *i. e.* to become the seat of catarrh. The popular idea, therefore, that dashing cold water against the auricle, and even into the ear-canal, is healthful or strengthening to the organ, is wrong.

Auditory Canal.—Of still greater importance is the hygiene of the auditory canal,—the canal leading down to the drum. Here we constantly meet with the bad results of too much washing, picking, scratching, swabbing, etc.

Referring to the anatomy and physiology of this part of the ear, we find that it is a canal lined with delicate skin, and, at its mouth, naturally smeared with ear-wax. The latter, therefore, is necessary to the health of the ear, or it would not be there by nature, and it must not therefore be looked upon as dirt.

This canal must be unobstructed, yet well supplied with wax: the first, in order to transmit waves of sound to the drum-head; the second, to keep out insects and worms or any small living creature, and also to keep off the fungus Aspergillus, for the latter will not grow on healthy ear-wax.

This apparent paradox in nature, the necessity for an open canal, and the presence of a gluey substance

ever forming at its outer end, is reconciled by the fact that the skin of the ear grows outward and *carries superfluous ear-wax and dust with it.*

It needs no great powers of reasoning to see how easily most things that people do for their ears or put into them, in health, tend to interfere with the operations of nature. So far as the entrance of cold air into the canal is concerned, it may be said that the peculiar spiral shape of this passage prevents the direct blowing of air upon the drum-head.

If, therefore, the ear-wax is to be looked upon as the natural protector of the ear and not as dirt, it should *not* be constantly and sedulously scraped away, as, unfortunately, it is in too many cases. *All superfluous ear-wax will fall from the ear in time if the organ is let alone.* Hardening and packing in of wax in the ear is an artificial product, usually caused by the gradual packing in resulting from the patient's unsuccessful or partial endeavor to remove this important substance from the ear. The skin of the auditory canal grows outward, and naturally carries with it scales of dead scurf-skin and old wax. It is very evident, therefore, that the use of any form of ear-picks, ear-spoons, and bougies, such as towel-corners rolled into cones, so-called "aurilaves,"* of which too much can hardly be said in condemnation,

* An "aurilave" is a most condemnable instrument, made by fastening a piece of sponge to a bone handle.

is at direct variance with the mode of nature in emptying the ear of anything superfluous. All such endeavors at cleaning the ear will push in much more than is brought out.

The cleanest people are generally those who pack the most wax back into their ears. A morbid idea of cleanliness leads them not only to swab their ears daily, but also to pour or drop into it a variety of fluids, as sweet-oil, glycerine, etc.

Now, as has been said, all this treatment of the ear is subversive of the law of nature regarding the ear's welfare and comfort. More than this, it usually leads in time to positive inflammation.

The scraping away of wax from the mouth of the auditory canal causes the ear to itch. This entails scratching; and the latter is likely to abrade the skin or directly to inflame it.

Abrasion may not only cause the ear to feel sore, but furnishes a moisture consisting of animal juices, which will quickly become putrescent, and thus favor the growth of a mould or fungus called the Aspergillus. The growth of this vegetable parasite in the ear leads to a stubborn and painful inflammation of the skin of the canal and of the drum-head. The latter part is especially sought out by the fungus, and its growth thereon not only inflames the drum and causes pain and hardness of hearing, but it has been known to penetrate the drum.

The use of sweet-oil, glycerine, etc., has its evil results, too, even if the inordinate wiping or picking the ear is not indulged in. *Sweet-oil*, so constantly and popularly employed in aural diseases, has no virtues whatever in the treatment of ear-disease, but, on the contrary, possesses positively bad qualities as an application to the ear. Because, besides having no good solvent effect on wax, it clogs the ear, increases pain, and does harm by its tendency to become rancid. When once put into the ear, sweet-oil, or any other fat, is usually soon forgotten, and allowed to remain there until it is rancid. This supplies the fungus alluded to with a most encouraging soil in which to grow.

Glycerine, too, has its ardent advocates, who consider it as bland as it looks. But glycerine has great affinity for water, and therefore acts like a caustic. Hence, glycerine, unless greatly diluted with water, when put into the ear, burns and stings until the ear is in the first stages of inflammation. There is no doubt that it possesses solvent power over ear-wax, but, when employed for this purpose, it should be well diluted with water, in the proportion of at least one of the former to eight or ten of the latter. In such a preparation only, can it be, or has it ever been, of service, and then only as a solvent to a plug of ear-wax which, in all probability, the patient had formed in his ear by his own meddling.

As the auditory canal is the only external conduit to the ear, and also one easily got at by both physician and patient, it has ever been a channel through which much deleterious matter has passed to the deeper parts of the ear, both before and since the time of Hamlet's father. It may be set down here as an axiom, that nothing should ever be put into the ear to cure toothache. This is a popular mode of treatment which constantly leads to injury of the organ of hearing, yet, so far as I know, never has cured a toothache. Not long since, there was removed by the writer, from the ear of a Swedish woman, three pepper-corns, which she had steeped in cologne water and placed in her ear sixteen years previous, for the cure of toothache. The latter passed off, as most toothaches will, in time, and the pepper-corns were forgotten. Years after this, a cold brought on a slight swelling in the skin of the auditory canal, and this, closing around the pepper-corns, which were almost equal in diameter to that of the auditory passage, greatly intensified the inflammation and excited the most violent pain, not only from the pressure of the skin upon them, but from their irritant qualities, which were once more brought out by the softening effect of the fluids which poured from the skin of the ear in its diseased state, and also by various matters dropped into the ear by the woman in her attempts to relieve her suffering. All such mismanagement of

the hygiene of the ear inevitably leads to pain and injury.

Still more common is the practice of putting almost numberless substances, chiefly fluid, into the ear for the cure of deafness. A laughable list might be given, consisting, in part, of such things as rabbit's fat, eagle's gall, neat's-foot oil, human urine, milk of women and of the cow, and vast numbers of matters equally useless so far as remedying deafness is concerned. There is now and then a more serious aspect to such purely nonsensical treatment of the ear. The above-named articles, as a rule, do no harm, but when one individual succeeds in inducing another to pour boiling oil into the ear, as occurred in a case which came under the writer's notice, then the utter folly of domestic treatment becomes apparent.

The great danger attending scratching the auditory canal has been alluded to when speaking of injuries of the drum-head. It will therefore be hardly necessary to allude specially to the folly of such practices.

Itching of the ear is at times intense, and the natural impulse is to scratch and relieve it; but this must be done with the finger, or not at all. If this will not relieve it, hair-pins and pins must not be used to scratch the canal of the ear, for reasons already given.

When itching of the ears keeps up, syringing with warm water may give relief; but usually there is some

diseased condition at the bottom of the annoyance, and the surgeon alone can give permanent relief.

Already, many directions as to what should not be done have been given. A few words are therefore necessary as to what may be done in the form of hygiene of the auditory canal. The auricles may be protected in cold weather *and in the open air* by ear-muffs, a veil, or a scarf, and these also protect the auditory canal. This is preferable to protecting the latter by putting cotton in it. The latter is more convenient, and of course less visible. If the ear is free from discharge, and yet suffers from pain whenever exposed to the cold air, a piece of cotton or wool may be worn lightly in the ear when in the open air—but only there and *never* in the house. The entire ear can be made tender by wearing cotton in it in the house, and its wax can be packed back by practising such a habit; it is thus kept too warm, the cotton acts like a poultice, and the ear is then not uncommonly drawn to a running. It is also a dirty habit, for the cotton is not likely to be changed very often if worn constantly, and not uncommonly it is pushed into the ear and forgotten. Hardness of hearing is thus gradually brought on.

Cotton may, however, be worn in swimming or diving, especially in the latter, in order to prevent the entrance of water into the ear. It is not easy, however, to keep it in the ear, unless it is held in by a cap of some kind.

Here, then, a caution must be inserted in order to further protect the ear and its functions. It does seem that a prolonged swim, or numerous repetitions of swimming in cold water, are more likely to produce inflammation of the ear, than a short and solitary indulgence in this summer sport. In addition to brevity of the bath, it would also be only safe to stop the ear with cotton during the swim. It is much better for boys and girls in a city to swim in a natatorium, where the water is never allowed to become cold. As for swimming every day in cold brook-water, as so many boys, and sometimes girls, in the country do, it is not only useless, but it is positively liable to injure both health and hearing. Bathing in the sea and surf has many points of danger to the ear, which must be noted. Prominent among these is the direct force of the waves and breakers, to which the ear may be exposed. A physician, a friend of the writer, while bathing in the sea, received a breaker against the side of his face and in his ear, resulting in a rupture of the drum and permanently defective hearing. But these cases are common in the experience of every surgeon who is employed in observing ear-diseases.

Other dangerous attendants of sea-bathing are the coldness and stimulating properties of the sea-water. In fact, so far as the ear is concerned, these two properties of sea-water render it an irritant to the ear, and the number of cases of ear-disease, from slight ear-

ache to a long-continued and painful inflammation of the ear, occurring at the seaside in summer-time, is something calling for attention not only on the part of the bathers, but of their medical advisers.

This dangerous quality of sea-bathing is only one more argument against its now indiscriminate use, and the positive abuses to which it has come. The old idea that nobody can catch cold, either in or out of the water, at the sea-shore, has been exploded long ago, in the minds of physicians of any experience along our coast, and should be extirpated from the minds of the public as soon as possible. A short bath once or twice a week may be a good tonic in some cases, if it is enjoyed; but as for staying in the surf until ears and lips, as well as fingers and toes are livid, as many, chiefly women, do, it is self-evident that catarrhs of all kinds must prevail among sea-side bathers, as in fact such diseases do. Fine swimmers remain in the surf, as is well known, for hours. Not long since, the writer was consulted by one of these celebrated swimmers, who had remained one hour and forty minutes, swimming up and down the surf at Cape May. The surf was high, and the water was cold — it was in June; and the result of this indulgence in the bath was a severe inflammation of the drum, for the water had entered the ear most exposed to the direction of the surf, constantly and with some discomfort to the patient, while in the water. In all

cases of sea-side bathing, if it is likely that the head of the bather is going under the surface of the water, the ear should be protected by cotton, held in position by an oiled silk cap.

After coming from the bath, the old idea that they cannot take cold is followed out by the bathers, and they sit about in draughts, the ladies taking this opportunity to dry their hair. This practice leads constantly to colds, and not uncommonly to earache. The sea-side is the place where perhaps one easily takes cold in all parts of the body.

In fact, it is to be hoped that the day is not far hence when it shall be a rare exception to see men, women, and children bathing in the surf. It is desirable that the salt water bath should be taken in a private bath-house, either in or near the hotel, where the temperature can be made to assure not only comfort, but in some cases the demands of health. The establishment of the latter custom would not only be vastly more judicious, so far as the health of the body and the welfare of the ear are concerned, but it would do away with much that is grotesque in dress and immodest in behavior.

Too much in praise of the sea-air as a tonic to health, and hence to those affected with ear-diseases of all kinds, cannot be said. We do not wish to be misunderstood on this point, for we have seen good results in ear-diseases from a residence at the sea-

side, but without the daily cold-water bath,—for reasons already given.*

Effects of Alcoholic Drinks and Tobacco on the Ear.—It has often been urged that both of these very useful things are injurious to the hearing as well as to other important senses of the body. Their *abuse* certainly is injurious to the ear as well as to the entire body and its organs of special sense.

So far as the ear is concerned, it may be said that the undue use of alcohol will injure the hearing in two ways, viz., by inflaming the throat, and thence the Eustachian tube and middle ear, and also by a congestion of the internal ear. It is therefore not advisable to use it when the ear is acutely inflamed.

Tobacco in all forms has received great condemnation from aurists. Smoking is the least objectionable; but chewing and snuffing are, without doubt, more likely to produce, respectively, catarrh of the throat and nose, and hence ear-disease and deafness. But moderate smoking of cigars and cigarettes cannot be shown to be injurious to hearing. Women who have never smoked become deaf at the same age and to the same degree as their brothers or fathers, who have smoked, and continue to do so, without any

* The injuries done to the ear by improper bathing, and cold bathing in summer, are graphically shown in a paper by Dr. Samuel Sexton, of New York city, in N. Y. Medical Record of May 4, 1878.

demonstrable effect on their deafness. In all cases, however, it may be dangerous to hearing to blow the smoke through the nose, as in that act the smoke is brought directly to the mouth of the Eustachian tube, and may set up irritation there. As cigarette smoke is usually thus blown out, this may be the reason of its supposed greater harmfulness to the ears.

Perhaps, too, the fumes of the paper-covering of the cigarette may have an especially injurious effect on the ears. With this proviso, that no smoke should be blown through the nose, a person deaf or only hard of hearing may be allowed to smoke say one cigar after each meal. A very important consideration in this question of smoking and its effects on the ears, is the time and place for the indulgence. An atmosphere loaded with tobacco-smoke is more injurious than a smoke in a properly-ventilated roon; and spending an entire evening in a crowded restaurant or club-room filled with smoke, is very bad for all kinds of catarrh, especially for catarrh of the throat, nose, and ears.

Effects of Great Noises on the Ear.—We have already alluded to the effects of sudden and powerful concussions on the ear. These occurrences as alluded to are mostly purely accidental, and hence unavoidable. But there are some noises which may do harm to the ear, and yet can be avoided; as, for example, shouting suddenly in a person's ear. This is not only

a cowardly act, but one which, coming suddenly on the individual and on the ear entirely unprepared for the shock, may result in permanent deafness. The shock to the nervous system is also very great and often disastrous.

Closely akin to this in effect is the constant clatter of machinery. This can best be guarded against by wearing something over or in the ear when exposed to such sounds. Boiler-makers are especially exposed to the bad effects of noises on the ear.

The nerve-power seems to be at last exhausted by the excessive and constant noise to which it is subjected. In the end, the result is similar to that produced by a great blow or fall on the head.

CHAPTER II.

THE CARE OF THE EAR IN DISEASE, INCLUDING THE RELIEF OF PARTIAL DEAFNESS AND THE EDUCATION OF PARTIALLY DEAF CHILDREN AND DEAF-MUTES.

The Care of the Ear in Disease.

THE care of the ear in diseased conditions would naturally be considered as treatment of the various diseases which may affect it. And, in fact, some allusion as to the best treatment has been made when speaking of the diseases of the ear, and also in what has been said about what should not be done. But there still remain some general directions which might be followed out with great benefit in a number of different diseases of the ear.

The Auricle.— Thus, for instance, in a large number of diseases of the auricle, some directions as to washing this part of the ear may be given with advantage to the sufferer.

In the acute and painful inflammations of the skin of the auricle, it will be found that washing it with

soap and water, or with water alone, will do more harm than good. When the skin is red, swollen, hot, and stinging, and perhaps broken and weeping, it will be found that to dust over it some finely powdered starch, or to smear it over with a bland mucilage of slippery elm or quince seed, or a bland oil, like sweet-oil, will give the most relief, until a physician can be called to prescribe other remedies.

So long as the inflammation of the auricle is limited to that part, no fears for the welfare of the hearing need be entertained; but watchfulness, lest the disease should spread to the auditory canal and drum, should always be maintained.

Auditory Canal.— When the ear runs, as it often does in children, no cotton, nor any such substance, should be worn in the auricle or the auditory canal, for it not only keeps in the discharging matter, but helps to further inflame the ear. It may be well said that it is "too heating."

The discharge from an ear should be removed as fast as possible, usually by the syringe, otherwise the odor from the ear becomes intolerable. Even when using a syringe regularly, sometimes the ear cannot be kept from smelling badly. To plug it up with cotton, as many very well-disposed parents do, is to dam up the pus, or mucus, coming from the deeper parts of the ear, and to make the ear smell more than it otherwise would. The cotton soon gets soaked with matter which rap-

idly putrefies; this soaked pellet of cotton softens and irritates the parts of the ear it touches, and the welfare of the ear and the comfort of patient and his neighbors are endangered. It is thus that most of the cases of *eczema*, or tetter, are excited in the ear. When the latter disease invades the canal, as it does not uncommonly, the patient usually makes the disease rapidly worse by rubbing up the corner of a towel or wash-rag, soaping it well, and running it down the canal as far as possible. This not only increases the disease, but packs in the cast-off matter, and lays the foundation of a soil most fruitful for the growth of the fungus Aspergillus.

The syringe is the only proper means of cleaning the ear, if the ear must be cleaned, and directions for its proper use have been given on p. 62. It would indeed be better for a number of children, as well as adults, if nothing but the syringe and warm water had been used in the domestic treatment of their ear-diseases. But, on the contrary, as soon as any one, child or adult, is affected with aural disease of any kind, every one in the circle of his acquaintance has some nonsensical remedy to suggest. These are usually in the form of "drops" of some kind of oil, than which nothing could be worse for the ear. It had better be let entirely alone, than that oil of any kind should be put into it. Oil will not dissolve ear-wax, therefore it will do no good when the wax gets plugged in the ear.

The folly as well as the harm of using it in other diseases of the external ear, has already been alluded to, and the utter impossibility of reaching the middle ear, with oil dropped into the external ear, is shown from the anatomy of this part of the ear.

The properly educated physician is the only one who can tell what is the nature of the ear-disease, and what should be done for it. The ear had indeed better be let alone, than that the wrong thing should be done for it.

It has always seemed so strange to the writer, that any old woman's remedy is preferred by those affected with aural disease. There was never such a remedy yet advised that was not folly and injury combined, and yet it is readily accepted and followed, while any advice the surgeon may give, is often looked on with suspicion, after the patient's mind has been deluded by "*old wives' fables.*"

A person afflicted with ear-disease should be very careful not to get the feet wet, nor to expose the body incautiously to great changes in temperature. In public places of amusement or instruction, a seat should be chosen out of draughts. Upon entering such places, the outer wrappings, furs, overcoats, and the like, should be removed. If this is not possible, then an extra shawl, or covering of some kind, should be carried on the arm to the hall, to be put on *over the wrappings* on leaving the audience-room. Always,

upon leaving warm audience-halls of any kind in the winter season, great care should be taken by every one to protect the heated and fatigued body from cold.

There is nothing more injurious to hearing — especially poor hearing — than chilling of the body, the feet or the head.

A sedentary or secluded life is also injurious to hearing. Any one partially deaf should avoid, if possible, close confinement of any kind. Hard study and the neglect of pleasant companionship will tend to make the hearing worse, as will all depressing influences, like nursing the sick, or the indulgence in immoderate grief. Natural feeling in sorrow cannot be suppressed, but weeping is very depressing to the hearing, as well as other functions of the body. All these facts should be borne in mind by any one affected in hearing, and the effort should be made to avoid anything which would tend to make the ear-disease worse.

The young, when affected in hearing, should not be permitted to retire from society, but should be most carefully induced to act like others of their age and social position. It might be said here, that when dancing is indulged in, great care should be taken that chilling does not occur, from exposure of the patient to cold night-air while the body is still very much heated. It should ever be remembered that at best the body is weaker as the night advances, and is a ready prey to

treacherous diseases, like catarrhs. The latter are especially injurious to the ears.

There yet remains a word to be said about the clothing, bathing, and sleeping attire and apartments of those hard of hearing. The under-clothing is of the highest consideration, and should be worn of a heavy kind by both sexes. The partially deaf should defy the cold by their heavy clothing. So far as concerns the feet, they should always be protected by heavy shoes, and in winter-time by rubbers. The latter are the only sure protection against moisture, and they keep the feet warmer than leather shoes. The latter may be comparatively light, if arctics or rubbers of some kind are worn. If they should cause the feet to perspire, the stockings should be changed in the middle of the day for dry ones. This should be done, in most cases, by every one, whether affected with ear-disease or not.

Great injury to the ears arises from the cold plunge- or the cold sponge-bath, especially if the ears get water in them; furthermore, the chilling of the body, which is sure to take place if a glow is not felt immediately after the bath, is likely to act unfavorably on the ears, especially in catarrhal ear-disease and deafness. It is in such cases that the mistaken idea of hardening the body and the ears is shown. *Cold* water must never enter the ears nor the nostrils, if it can be kept out.

The person affected with deafness, especially that arising from catarrhal disease in the throat, nose, and middle ear, should not sleep without an undershirt, nor in a draught. If the room is large and the patient sleeps alone, the windows should be closed in cold weather, and ventilation sought through an adjoining room. If the room is rendered close by more than one person's presence during sleeping hours, great care should be taken that the matter of ventilation is not overdone, as it is apt to be in our country, by allowing too much air to enter the apartments. I know that we hear a good deal about "hardening" people or making them "tender," but the former is not accomplished by sleeping in the cold, nor will being comfortable make them weak and delicate. All these attentions are demanded in the case of children.

In them, especially the younger ones, from one year to eight or ten, deafness is often attended with disease and stoppage of the nose. The child then breathes through its mouth. This, as already said (p. 95), is very injurious to the throat and ears, the chest, and the general health and development of the body.

The child's enunciation is ruined by it, causing him to "talk through his nose," as it is termed; but in reality that is just what it does not do, for his nose is stopped up. The nasal sounds are lost from

his speech, and hence the peculiar and disagreeable twang to his voice.

His nose collapses and looks pinched, the expression of the upper lip is spoiled, and his face, thus being altered, becomes foolish and stupid-looking. The nose is a kind of sifter of the air breathed through it, and it also warms the air we draw through it before it enters the lungs. This advantage is lost if the nose is stopped up.

At night the child chokes from dryness of the throat, and snores because forced to sleep with his mouth open. His rest is disturbed, his health fails, and his hearing grows worse.

Even after the obstructions are removed, either by nature or by art, the child may have learned a bad *habit* of breathing through its mouth. This must be looked after, and the child, if old enough, must be reminded to breathe through its nose. Much can be overcome by thus correcting the child from time to time. It is good for the ears, as it ventilates them, to oblige the child regularly, three or four times a day, to close his lips and breathe forcibly through his nostrils for several minutes. This cleans the nostrils, and brings to them the natural tonic of breathing air *through them* into the throat and lungs.

It is absolutely necessary to the health of the nostrils to breathe air through them, for that is their function; but it is just as unnatural and injurious to

snuff up water into them. A moment's reflection will show that they are air-passages and not water-conductors.

Hence, in applying liquid medication to or through the nostrils, it should always be warmed, and never snuffed hard into the nostrils, but it should be rather poured into first one and then the other nostril, until it is felt gently trickling into the throat. But nothing which causes pain, stinging, or tingling in the nostrils should be used in them as medicine.

If the patient applies nothing to his nostrils or ears without the advice of an intelligent physician, no danger will be likely to occur from treatment applied to these parts.

Hearing-Trumpets.— A child is rarely obliged to use a speaking- or hearing-trumpet, although many a child might be kept from becoming a deaf-mute, if he were taught to speak by using some form of trumpet to aid him in hearing.

There are many adults, however, who, from the incurable nature of their deafness, are obliged, or should be obliged, to use a hearing-trumpet. Such an aid to hearing is not only an advantage to them, but a great comfort to their friends, as it saves the latter a painful effort to talk.

What form of hearing-trumpet is the best cannot be described here, as different patients require different forms of trumpets, tubes, etc. The best plan for

a deaf person to adopt in choosing this instrument is to go to a reliable instrument maker, and try the samples until he finds one that makes him hear well. Some kinds of deafness, as those where the nerve is paralyzed by a blow on the head or by disease in the brain, no trumpet can help.

All instruments of any value must, from the nature of acoustics, have a certain size, and hence must be plainly visible; otherwise they will not augment the sound by resonance. Hence, all invisible auricles, etc., are self-evident frauds, as they are too small to augment sound. The very small gold and silver tubes, or "auricles," as they are called, are very expensive, and, except in the collapse of the auditory canal in old people, are utterly useless.

They are, in fact, worse than useless in all cases but those mentioned, since they fill up the ear and render the patient deafer.

False drums act in the same way excepting where the natural drum is perforated. To employ them, therefore, in catarrhal deafness, when the natural drum is thicker than usual, is, of course, to make matters worse. It amounts to filling the ear with a foreign obstruction.

Education of Partially Deaf Children and Deaf-Mutes.

Deaf Children.— There is a large number of deaf children who are by no means deaf and dumb, hav-

ing lost their hearing after they had learned to talk. After a child has once learned to talk, no matter how deaf it may become, it should be encouraged in every way to continue to use speech, and not signs, in communicating with friends and family. In order to induce him to continue to speak, his signs must be disregarded. All children who grow deaf, will soon begin to make signs, and unfortunately the latter are encouraged by being answered in the same way. It would be very easy to make such a child look at the mouth and understand the signs made by the lips.

But many children are too hard of hearing to escape being under disadvantages at ordinary schools, where they are competing with hearing-children. Such children, on account of their bad hearing, are often imposed upon both by companions and instructors. Do as they may, such children must fall behind in their studies. But it is not desirable to isolate these unfortunate children in separate classes, because it not only draws painful attention to them, but it is highly desirable that they should continue their studies among those with whom their lives are to be spent.

Nevertheless, some allowance should be made for their defective hearing. The first step in this direction is to find out whether the child is deaf or inattentive; if he is deaf, he surely cannot fail to be inattentive. A child is, as a rule, unaware of its de-

fective hearing, especially a young child at the beginning of his deafness; it is therefore the duty of his elders to find out and determine the amount of his deficiency. It can be expressed accurately in feet and inches.

Dr. C. J. Blake, of Boston, has shown that of 8715 cases of ear-disease, 2175, or 25 per cent., were children under 14 years of age, all of whom were pupils in the public schools.

In such children, the distance at which they can hear the teacher's *voice*, should be carefully measured by testing with words and sentences, and there they should sit, the children with good hearing being placed farthest off.

Nothing but the teacher's voice should be used, and that in ordinary tones in these tests, for the child goes to school to hear those sounds.*

Education of the Deaf and Dumb.— Physicians are constantly called on to decide whether a child is deaf

* See Dr. Sexton's views in editorial notice in the N. Y. Med. Record, March 15, 1879. "A careful, scientific examination would often reveal that some children in every school were suffering from disease of the ear and deafness, entirely curable, if taken in time. By being properly taken care of, they would regain not only hearing, but they would learn more at school, and would be enabled to get rid of a disease of the ear, which would otherwise grow worse, and finally, becoming irremediable, render them permanently deaf. There is no greater fallacy in the public mind than that a child 'will outgrow deafness.'"

and dumb, and if it be, to suggest a cure if possible, and if not, to advise a plan for the proper education of the little patient. In very young children, it cannot always be readily decided whether total deafness, and hence prospective dumbness, exists or not. Without being obliged to determine whether the child is totally deaf, a physician may find, on examination, that it is too deaf to learn to talk by hearing others speak, and without losing further time, he should advise its parents to arrange for its proper education in another way. The education of deaf-mutes is accomplished in two ways, viz., by the use of signs, "finger language," and by the use of "lip-reading" and by phonetic writing, or visible speech.

Before describing any of these methods of education of deaf-mutes, it must be borne in mind by the reader, that it is not the object of this book to advocate any one method to the exclusion of the others. It is believed that all have advantages and disadvantages. The only object in alluding to these various methods, is to let parents know what can be done for their children afflicted with deaf-dumbness.

The sign-language is the most common form of communication in the institutions for the mute in this country. It has been found that when this form of language is used, no other method can be successfully introduced at the same time.

Lip-reading, *i. e.* the ability on the part of the

mute to understand what is said to him, by watching the lips of the speaker, is taught very largely in Germany, and is often called the German method. By this system, also, the *dumb are taught to speak* as well as to understand speech.

Their articulation, of course, is not like ours, being peculiar and unnatural in sound, yet entirely intelligible. The writer has conversed in ordinary tones, in German, with German deaf and dumb children in Vienna, and was perfectly understood by them, the children replying in German that they perceived he was a foreigner, so delicate was their perception of the motion of the lips.

Phonetic writing, or visible speech, the system of A. Melville Bell, is based on the physiological action and position of the vocal organs during speech, and is practically an alphabet of sounds, in which the symbols, either printed or written on the black-board, inform the child how to place its lips, tongue, and palate, and produce a vocal sound. It has been successfully employed in England and in this country. Lip-reading and visible speech may be of great value in the education of children who have become deaf after having learned to talk in the first four or five years of life. Their conception of what speech is, and their ability to use it, are invaluable aids in their further education by means of lip-reading and articulation, or by visible speech.

Hence, no matter how deaf a child may become after it has once learned to talk, it should be discouraged in the use of dumb signs, and encouraged to go on talking.

It is desirable that a mute who is to be taught lip-reading and talking should begin his exercises before he is seven years old. It will then require about eight years of study and practice in this way, but at the end of that time he will be able in most cases to converse with and understand any one he meets. In some instances, mutes thus educated can converse in several languages.

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